International
Journal of Orthodontia
and Oral Surgery

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VOL. 23 OCTOBER, 1937 No. 10

Orthodontia

PRESIDENT'S ADDRESS

NEW YORK SOCIETY OF ORTHODONTISTS*

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BECAUSE of the fact that Article 1, Section 1 of the Constitution and By-laws of this Society specifically states that the president shall present an annual address, and not through any choice of mine, I am standing before you to carry out one of the few remaining duties of my incumbency.

To say that it has been a pleasure to serve the Society this past year is putting it mildly. The confidence you have reposed in me by elevating me to this honor I trust has not been misplaced, and I wish to take this opportunity to express my thanks for the privilege of serving.

If my administration has been a successful one, I can accept only a minute part of the credit, namely, the good fortune to have selected competent Executive and Advisory Committees whose only thoughts have been cooperation and a keen sense of duty to the Society. Too much credit cannot be given Doctors Riesner, Young and Keller for their many hours of toil to make our meetings a success, and I wish to express my sincere gratitude to them for their loyalty.

Doctors Murlless, Kelsey and Blumenthal, the Board of Censors, have carried out the duties of that Board in a most efficient manner and have made many constructive suggestions from time to time which will be of great benefit to the Society. They, too, have my heartfelt thanks for their help and guidance.

The Advisory Committee, composed of Doctors Waugh, Eby and Porter, has been most active, and has been of great help to me, for which I am truly grateful.

*March 15, 1937.

It was at their suggestion that the Committee on Public Information was formed, and, though their names are not included in the membership of that committee, they are being of great help in formulating the groundwork which is of vital importance for its success.

When I was instructed to formulate this Committee last summer, it seemed most feasible to select members from each of the key points strategically located within the jurisdiction of the Society, and this has been a wise move in many ways, the chief one of which is the selection of the right type of dentist and pediatrician for our mailing list. When finished, this list is expected to number 2,000 or more, to whom informational material will be sent. As you can readily visualize, this means the sending of educational reprints into the most important sections of the northeastern part of the United States. Only recently it has been my good fortune to obtain the names of the deans and instructors in all the recognized dental schools in the country, these to be added to our list; so perhaps we are beginning to broaden out nationally already at the proper point, namely, in the schools of learning.

The Committee has investigated the possibilities of reprinting articles by prominent professional men on the subject of orthodontics and is not yet satisfied that it has obtained satisfactory manuscripts, and questions whether it will be able to procure signed articles which would suit our purpose.

At the meeting of the Committee last evening it was decided to prepare an anonymous booklet which would be based on much of the material which has been made available, with the idea that this might be sent to our mailing list, after the full Committee approval, perhaps as a part of the document used to contain the names of the officers and members of the Society.

I am sure the Committee begs your indulgence at this time, for it is imperative that we proceed with great caution.

I have been pleased to be called upon for informal conferences by the Committee and Mr. Anderson, and have enjoyed participating in their efforts. I sincerely believe that this step to make orthodontics better known and understood among dentists and pediatricians will prove to be one of the most important projects we have ever undertaken and that, before this first year of experiment has ended, the results will show that activities should be increased and their scope expanded.

Dr. Nicolai and the members of his Committee are to be congratulated on the time and effort they have expended in getting this pioneer work started, and I wish to emphasize the fact that the Society has been extremely fortunate in obtaining the services of Mr. Anderson, whose vast experience in publicity work for the New York State Medical Society has proved of inestimable value to us in this great and important undertaking.

Last year in his president's address, Dr. Blumenthal called attention to the recent passing of a reorganization program which was to be presented before the American Society of Orthodontists in April, 1936, at the annual meeting in St. Louis. At that time he urged all the members of that Society to attend that meeting to support a movement for its acceptance. This plan was not ac-

cepted for various reasons but was referred back to the Committee on Constitution and By-Laws Revision for further change and to be presented for acceptance at the meeting which is to be held in Chicago during the week of April 19, 1937.

I, too, wish to urge all of our members who are members of the American Society of Orthodontists to make a special effort to be present at the time this revision is discussed, for it is a great step in the right direction for the future of organized orthodontics, and you are duty bound to have a voice in the formation of a revision which is agreeable to everyone concerned.

In closing may I call to attention the fact that you are about to elect an entire new personnel for the ensuing year. That the affairs of the Society will be in excellent hands, there is no doubt; and I wish, at this time, to congratulate them and to assure them that they may feel at liberty to call upon me in any capacity that will assist them in carrying their administration to a successful conclusion. Again may I thank you for having entrusted me with the presidency of the Society for the past year, an honor which I shall always cherish.

IS THE PROFESSION MEETING ITS RESPONSIBILITY TOWARD OPEN-BITE MALOCCLUSION?

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IN PRESUMING to address this Society on matters relating to open-bite malocclusion, let me say that I consider this paper somewhat of an anomaly as compared with what is usually expected of presentations before this, and similar organizations, in that I make no claim to any valuable or definite knowledge of the subject of open-bite. It is, rather, the lack of that knowledge, in which I believe I am joined by the profession, that I wish to discuss.

In doing this it is my hope to interest this Society, as an organization, in undertaking a program for research into the etiology of open-bite malocclusion, believing that more rapid enlightenment on this subject can be secured through organized than through individual effort.

In describing the condition referred to as open-bite malocclusion, no attempt is made to employ a more scientific terminology, for such a terminology requires for its conception a more accurate etiologic and diagnostic knowledge than is now at hand. Until such time as we have this knowledge, we must content ourselves with the time-honored phrase "open-bite," which after all describes the condition with a startling degree of accuracy.

Perhaps the best appraisal of our knowledge of the subject, and such advance as has been made during the past forty or fifty years, can be derived from a brief survey of the literature relating to open-bite malocclusion appearing over that period of time. I shall not attempt to make a complete review of this literature, for such would be both tiresome and pointless, but the opinions of a few of our outstanding writers should be accepted as expressing our professional knowledge and as following the trend of thought and opinion through this period of our development.

Talbot[1] in his *Irregularities of the Teeth,* first edition, 1888, referring to the subject under the title "Failure of Anterior Occlusion," says "this irregularity occurs at the time of development of the first and second molars which erupt at greater length than the anterior teeth." In his second edition,[2] published in 1890, he refers to the subject under the title "Imperfect Occlusion," and associates the condition with a short ramus.

Guilford,[3] in his *Orthodontia,* 1893, refers to open-bite as "Lack of Anterior Occlusion" and says, "It is the one of all others that is least amenable to treatment."

Angle,[4] in *Malocclusion of the Teeth,* seventh edition, 1907, says, "The restoration of the teeth to normal occlusion by movement of the upper centrals and laterals downward and inward is usually not difficult, these being, as before

Read at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, April, 1937.

noted, the easiest tooth movements to perform,'' but in most cases this is ''only a minor part of the difficulties encountered,'' and apparently he feels that a large percentage of the cases treated will result in failure.

Case,[5] in *Dental Orthopedia,* 1908, says, ''while there are doubtless certain isolated cases of open-bite malocclusion caused from direct inheritance; from the inheritance of syphiletic taint; and even from thumb and tongue-sucking, etc.; these are not the common, typical characters of irregularity to which the author refers.''

Although Case appears to have regarded the great majority of open-bite cases as what he termed ''typical characters of open-bite malocclusion,'' and as being treatable; he, nevertheless, recognized that numbers of open-bite cases presented etiologic factors setting them outside the field of successful orthodontic treatment.

Strang[6] in his *Orthodontia,* 1933, gives no consideration to open-bite malocclusion as such, referring only to those cases diagnosed as infraversion of the incisors which are clearly the result of individual habits.

Dewey and Anderson,[7] in *Practical Orthodontia,* fifth edition, 1935, say, ''It is apparent in many open-bite malocclusions that a tongue habit need not be considered as an etiological factor. The interference to vertical growth may be a result of an obscure cause, or group of causes, in no wise associated with the teeth. Our present medico-orthodontic knowledge is extremely hazy in regard to this type of malocclusion. Under the circumstances, if treatment is instituted at all, it should be done with reservation as to promise of success.''

The *Year Book of Dentistry,*[8] 1936, commenting upon open-bite, says, ''Open-bite cases have received their share of attention, for no phase of orthodontic treatment offers more obstacles to satisfactory conclusion than this problem, which is usually due to a number of factors. General factors such as metabolic disturbances, heredity, intra-uterine influences, maldevelopment of the mandible, maxillary and/or mandibular insufficiency, disharmony in the temporomandibular articulation, endocrine complications, muscular activity and inactivity and childhood disorders such as rickets may be primary cause or secondary influence in an open-bite malocclusion.''

Blair and Ivy[9] in *Essentials of Oral Surgery,* 1923, say, ''The open-bite is partially due to deformity of the upper jaw, and the surgeon must not expect to be able to entirely correct it in all cases by an operation on the lower jaw. A better result will come from restoring the lower jaw to its proper form and correcting the remaining open bite, either by bringing down the upper incisors with an orthodontic appliance or by extending them with porcelain crowns. . . . All except one of the cases of this kind that we have observed have shown evidence of early rickets, which we think is the ordinary etiological factor. In most of the cases we have observed, the open-bite seemed to be due partly to a bending of the lower jaw in front of the second molars and partly to lack of development of the alveolar process on the anterior part of the upper jaw.''

Mead[10] in *Oral Surgery,* 1934, says, ''The open-bite is partially due to deformity of the maxilla, and any surgical procedure may not entirely correct the deformity. Orthodontic assistance or restorations may be necessary.''

As forming the basis for diagnosis and treatment of open-bite malocclusion, the views expressed by the earliest of the authors are about as helpful as those of later date, not to mention that some of the most modern works either entirely ignore it or frankly admit a lack of sufficient knowledge for a discussion of the subject.

No criticism of the authors of these textbooks is intended, for we only expect them to present a résumé of accepted principles, or the principles of individual schools of thought.

Of outstanding value toward a better knowledge of the subject of open-bite are the contributions of Hellman and Howard.

Hellman's[11] observations, based on work done at the American Museum of Natural History, indicate that with open-bite, a short ramus and body of the mandible are accompanying phenomena rather than an infraversion of the anterior teeth or a supraversion of the posterior teeth, or a combination of the two, as commonly believed.

Howard,[12] while considering the subject with relation to facial lengths and infraversion and supraversion of the teeth, arrives at about the same conclusion as Hellman.

These conclusions, which seem reasonable in the light of our present knowledge, while seeming to throw us into an even greater confusion regarding the etiology and treatment of open-bite, do at the same time afford much added knowledge regarding the feasibility of securing marked permanent changes in the plane of occlusion by bone growth secured through the agency of appliance stimulation. This knowledge should aid us materially in prognosing the result of treatment of other types of malocclusion involving marked changes of the occlusal plane.

At this point, permit me to emphasize again that it is not the purpose of this paper to discuss the etiology, diagnosis or treatment of open-bite, but rather to consider the relation of orthodontia as a profession to the subject of our limited existing knowledge of this condition and the responsibility thereto of the American Society of Orthodontists.

I believe that those workers who have devoted the most time, energy, and thought to this subject will agree that individual efforts will avail little toward even a relatively speedy solution of this baffling situation. This is due in large part to the limited amount of material available to any individual, to the wide variation in the methods and observations of different individuals, and the unwillingness, inability, or indifference of individuals in general, to regard seriously the need for standardization of methods, observations, and reports.

No better explanation of the reasons why diverse individual efforts are almost valueless is needed than the report by Hellman[11] of responses to questionnaires on this subject.

Another point is that the treatment of these cases must invariably cover such an extended period of time, to which must be added the time necessary to determine the result, that the working years of an orthodontist are insufficient to cover many such cases taken consecutively and, as I have said before, no practice carries any volume of them.

As a beginner in the practice of orthodontia, I often wondered at the apparent reticence or reserve of older practitioners in offering any really constructive information regarding the treatment of open-bite.

In my ignorance, I supposed that an orthodontist who had enjoyed a full practice for any considerable number of years must have come in contact with a large number of all types of malocclusion including open-bite cases, undoubtedly had treated many of this type successfully, and certainly was qualified to diagnose and treat open-bite cases with a degree of success comparable to that secured in other types of malocclusion. In fact, if a young man at that time believed all he heard, he might reasonably have assumed that anything short of a hundred per cent of success indicated a failure to have received training from the proper source. As a beginner, he might also have been encouraged to assume that bone would develop in response to mechanical stimulation as promptly and with as much certainty as vegetation could be expected to respond to scientific fertilization. A few years of practice, however, sufficed to demonstrate that there was much to learn aside from mechanical technique, and that he must learn to evaluate the information at his disposal if he were to avoid unnecessary mistakes and embarrassment.

The right of a profession to be accepted and to live in the public mind must depend upon the mastery of those problems for which it was created. It is not sufficient for us that we treat with a reasonable degree of success the large majority of the cases presenting for treatment, while failing utterly to offer any consistent solution to the treatment of some particular routine type of malocclusion *unless* we have and are making every available effort toward its solution.

The public has a right to expect such an effort on our part, or if open-bite can be determined not to be an orthodontic problem, then it should be definitely removed from the field of orthodontia and referred to such other specialty as may rightfully claim it.

Is it a surgical problem, or does its solution belong to the field of endocrinology? Who can say at this time? Certainly it cannot be claimed for orthodontia until that specialty has a far better grasp of the subject than at present. Merely common consent and visual appearance, so far, have been responsible for the acceptance without question that open-bite malocclusion is an orthodontic problem.

Will the profession accept this challenge or will it drift for another fifty years content to let nature take its course, while a few hard working, studious, conscientious men attempt, by self-sacrifice, to labor with the problem individually when, for its speedy solution, it should have the support and backing of our organized profession?

CONCLUSION

1. Our knowledge of the etiology, diagnosis and treatment of open-bite malocclusion is woefully insufficient to enable us to handle such cases with even a moderate degree of satisfaction either to patient or to operator.

2. No marked advance during the last half century has been recorded so far as an ability to handle these cases is concerned.

3. Research so far attempted has served to indicate the need for organized rather than individual effort.

4. Questionnaires and symposiums are of little practical value in arriving at a solution of such a problem.

5. The point of this presentation is to show the need for an organized attack upon the problem of open-bite malocclusion and the responsibility of the American Society of Orthodontists as an organization toward the problem.

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BIOMECHANICS OF ORTHODONTIC PRACTICE

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IT WAS with considerable pleasure that I accepted the invitation of your committee to present a paper before this Society, as one of a group along with those of my good friends, Drs. Hellman and Woodbury. Variance of opinion has existed among us, and I sincerely hope that our discussions here may result in a fuller coalescence of our views. The task assigned to me was to cover more particularly the mechanics of orthodontic practice. Obviously this could not be successfully done without some consideration of the various factors entering into the growth problem, with which, so far as is possible with our present knowledge, mechanical procedure must harmonize. So, in the title of this paper, I have used the word "biomechanics," a term suggested by Hellman some time ago.

Notwithstanding the extensive research being done by a number of orthodontists, imbued with biological inclination, as well as by other students of biology, sufficient evidence has not yet been evolved to establish any definite knowledge concerning the etiology of malocclusion. The growth process in the human being is obscure; its study, undoubtedly, is very fascinating, and our specialty is fortunate in having so many of its own members who are capable of doing this type of work. Some day, as a result of their efforts, and the work of others who will follow them, the science of orthodontics may become established upon a sound biological basis, but in the meantime we must still face our problems in treatment, directed almost wholly by theories and clinical experience. For the workers in this field I have the greatest admiration; they are endeavoring, in our behalf and in the interests of humanity, to discover what is taking place in the growth process that would account for the malformation of the jaws and dental arches so common today. It is not my desire to be understood as decrying the efforts of these men, but the difficulty in arriving at definite conclusions concerning the etiology of malocclusion is partly responsible for the fact that we have no scientific basis from which to approach the problem of treatment, thus resulting in confusion. Greater progress might possibly result if those men with biological tendency would place a higher value upon knowledge gained through clinical experience, for from this source we have learned considerable.

Dr. Arthur Thornton Taylor, of Sydney, Australia, recently visited a number of orthodontists throughout the world, as well as several dental clinics in which orthodontics was practiced, and his impressions in "Scanning the Orthodontic Horizon"[1] give us some idea of the diverse views concerning the biological as well as the mechanical side of our specialty.

Read before the Great Lakes Association of Orthodontists, Toronto, Oct. 19 and 20, 1936.

About ten years ago, or thereabouts, there was a great cry that the pendulum was swinging too far to the mechanical side. It is just possible that it is now swinging too far to the biological side. Personally, I feel that the average man in our specialty, with the biological tendency highly developed, does not appreciate fully the value of good mechanics in orthodontic treatment. Anent this statement, Dr. Taylor says: "As one would expect, the best technicians for the most part had the least scientific background, and often the more scientific men were so absorbed in theoretical considerations that they carried the same technical equipment with which they commenced their orthodontic careers, or, with a good technique, perhaps were unable to achieve the results their theories taught them to be desirable."

Those who met Dr. Taylor will, I feel, agree that he appears to have a well-developed analytical mind; so his observations, after visiting so many men in different countries, should be worthy of consideration. He cited the many theories put forth to account for malocclusion, and said: "I found nothing new in etiology. Beyond a few local causes, overemphasized by some and ignored by others, we are still up in the air where Brash left us in 1929." Concerning anchorage, he said: "I felt that it was at once the most misunderstood, the most abused and yet the most important principle in the technique of treatment," and also that "One could see all sorts of attempts mechanically to achieve the impossible."

In Oppenheim's preface to his most recent contribution, "Biologic Orthodontic Therapy and Reality,"[2] he says: "The scanty reports now existing in the literature, dealing with the changes in human tissues under orthodontic influence, have been the cause for further research by the author on a wider basis. This research proved the irrefutable fact that there is no biologic orthodontic therapy. The possibility that biologic treatment could only be effected through the use of the lingual arch appliance, which has been claimed as a fact, has been found to be a fallacy." He further says: "Painlessness and firmness of the teeth are the sole criteria for judging that no severe damages are being effected. The clinical evidence of tissue damage is expressed in pain and in loosening of the teeth."

A study of the literature, of both the biological and the practical sides, increases our confusion, because of the many opinions presented, and makes it difficult to formulate our plan of procedure in the treatment of each individual case. I feel that extensive clinical experience is still our best guide, and the younger men should elect to follow the technique of those longer in practice whose results seem to have proved the most satisfactory, at the same time acutely observing what is taking place in the mouths of their own patients under treatment until such time as they may be able to formulate opinions of their own.

Our first step, when undertaking the correction of a case of malocclusion, is to obtain accurate impressions of the dental arches. Before inserting the plaster for the maxillary impression a line about one-eighth of an inch long should be drawn with an indelible pencil over the median raphe about opposite the first permanent molars. This mark will appear upon the impression, at which point

a slight groove should be made; this will stand out as a ridge upon the cast. We thus have a record of the median line of the palate, which may later be connected with the median line of the face marked upon the labial surface of the cast. Other essentials are full-mouth x-ray pictures and full-face and profile photographs (or x-ray pictures of the head) of the patient. There are other points which must be observed and marked in order that a careful analysis of the case may be made and a definite plan of procedure formulated. At this stage accurate technical detail is most important, and if neglected may result in an endless series of difficulties.

The vertical plane of the head must be established, and many schemes have been suggested to obtain this, one of the most scientific and reliable of which is probably that being worked out by Broadbent. So far my own has been a very simple one, and has been criticized as being unscientific. However, this factor, as well as the etiology, has not yet been settled, so individual judgment must still come into play. The profile picture is the more important one, and a careful study of the dental arches and face of the patient will enable one with experience to mark upon the photograph this plane, which Angle at one time called the "line of harmony." We now decide the type of face, and also whether the mandible is normal in its horizontal growth or otherwise.

In a patient of the straight type, with a normal mandible, the line of harmony should touch the glabella and the anterior part of the chin; in one of the mental eminence type, with mandible normal, the mental eminence would extend slightly forward of the line of harmony, the amount being governed by the prominence of the eminence. A profile photograph without any record of the line of harmony is practically worthless. The median vertical line of the face is also ascertained at this time, and this should be marked accurately upon the labial surface of the maxillary cast. It is now that we decide whether or not there is any lateral shift of the mandible, and the median line of the latter is marked upon the mandibular cast. This is all done before the casts are trimmed, and establishes a guide for the trimming. The resting lip lines are traced approximately upon the casts at this time, and the latter are now ready for the laboratory technique. The bottom of the base and the top of the capitol are trimmed first, and the median line, traced upon the labial surface of the maxillary cast, is now extended over on the palatal surface of this cast and connected with the point marked over the median raphe opposite the molars. The posterior surface of this cast is trimmed at a right angle to this line, and the line also extended upon this surface. The posterior surface of the mandibular cast is now trimmed parallel to that of the maxillary cast. If the mandible is true to center, the median line marked upon the labial surface of both casts will form a continuous line. The median line of the posterior surface of the mandibular cast may now be obtained by extending upon this cast the line previously inscribed upon the posterior surface of the maxillary cast. This may then be connected up on the floor of the mandibular cast with that upon its anterior surface. We thus have the median line upon the occlusal surface of both casts, a detail of extreme importance. If there is a lateral shift of the mandible, as shown by the vertical lines on the labial surface of the casts in Fig. 1, the median line at the posterior

of the mandibular cast cannot be obtained so simply. To overcome this difficulty, have the patient, looking in a mirror, practice biting the mandible true to center, and then with compound obtain a bite in this position, with the material so placed that it will not hide the anterior teeth. With this condition present it is best to have an extra pair of casts, and upon the back of one maxillary cast build an extension and cut grooves upon the occlusal surface to form a locking surface; now place this and the mandibular cast into the bite and extend the mandibular cast to harmonize with the extended portion of the maxillary cast. Now you have an extra pair of casts, as if on an articulator, with the mandible biting true on center, as shown in Fig. 2. The median line of the posterior of this mandibular cast may now be obtained in the regular way. Fig. 3 shows the occlusal view of such a pair of casts.

Another important feature in the marking of casts is the transverse line, which is drawn at a right angle to the median line, and placed at the contact point between the second premolar and the first molar upon the more distal side, if there is any difference in the forward displacement on either side. This registers a permanent record of the relative axial relations upon the two sides, as shown in Fig. 4, in which we note a greater forward displacement of the teeth upon the right side than upon the left in both arches. These transverse lines correspond with those which I have upon my Hawley charts. It is needless to discuss further the value of these landmarks. The balance of the detail of trimming the casts is familiar to all.

Many years ago there was an interesting discussion concerning what happened in the soft tissues overlying the palate when anterior teeth were carried back. Fig. 5 shows the palatine surface of the original cast of the case shown in Fig. 1, in which there was a great maxillary protrusion, alongside of which is a later one after the removal of the first premolars and the movement back of the six anterior teeth. The crests of the rugae upon both maxillary casts were outlined with a pencil. There was, fortunately, a slight transverse groove just behind the central incisors and another about opposite the first molars. The distance between these two points, measured with calipers, is greater in the original than in the later cast by 3 mm. Note the bunching of the rugae in the cast after the movement back of the anterior teeth. This, it would appear, solves this problem.

In the choice of appliance, and its manipulation, I have many times said that anchorage is our chief problem, and as Taylor has stated, as quoted before, is "the most misunderstood, the most abused and yet the most important principle in the technique of treatment." The simpler forms of appliance, such as the ordinary expansion arch and the much-used lingual wire, possess the least possibilities in the establishment of anchorage, and are thus the least efficient except in simple cases. The high labial arch of Lourie is an improvement over these. The lingual wire is ideal where only expansion of the dental arches is required, but its use, as advocated by Mershon and others, in complicated cases, must have resulted in more failures than any other possible factor. Imagine, in the treatment of a case in Class II (Angle), the use of a lingual wire on the mandibular teeth and the application of intermaxillary elastics, as advocated by

many operators. Will the lingual wire enthusiasts show us their results in these cases several years after the removal of appliances? This is a challenge which should not go unanswered if the science of orthodontics is to progress. Sufficient anchorage is rarely obtainable from the teeth themselves, using any type of appliance, for the successful correction of the average case; in many instances we must resort to the occiput.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

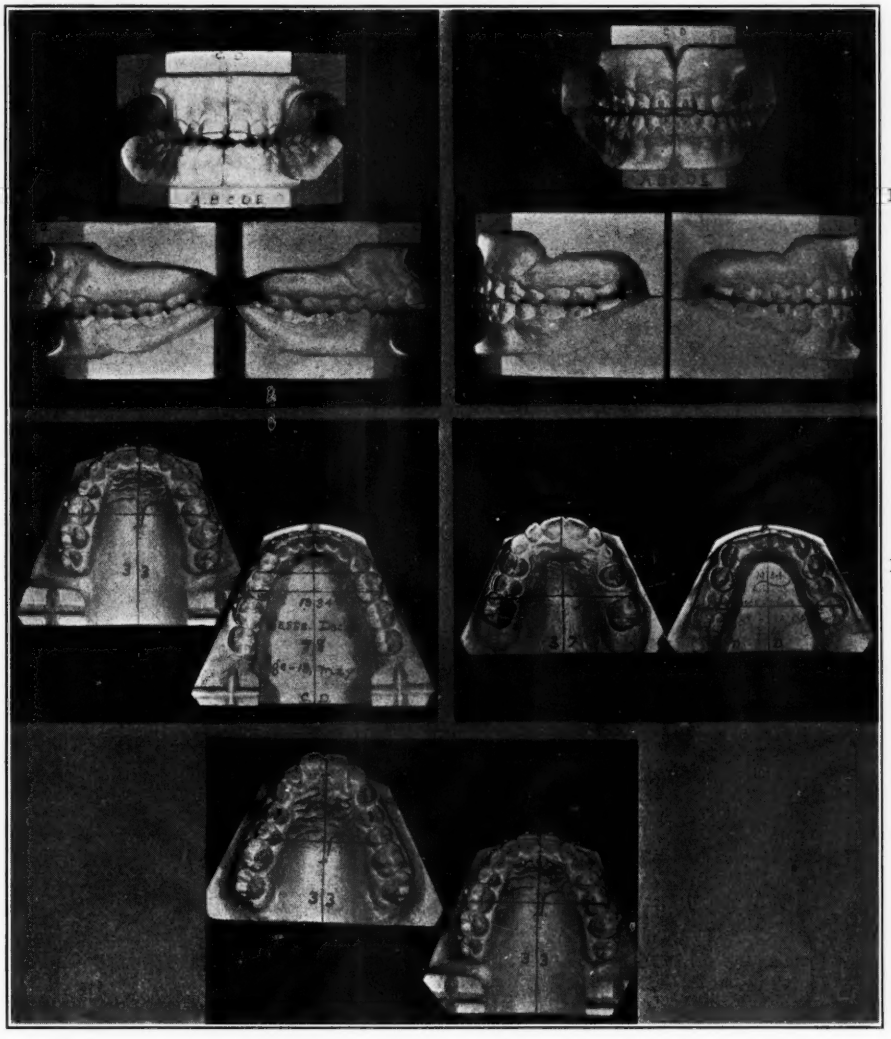


Fig. 5.

About the year 1910 Angle, having realized the shortcomings of the ordinary expansion arch, introduced what he called the "working retainer." This was the beginning of the pin appliance. Almost immediately, different men developed improvements in this mechanism and Angle forsook it and introduced the ribbon arch. At this time his view was still similar to that which he earlier held when he thought the old expansion arch was ideal, except that he now felt that in some instances the teeth should be moved bodily rather than tipped. He wanted a means of attachment of the arch wire to the teeth so that bodily

horizontal movement could be obtained, and at the same time permit the teeth to slide along the arch wire like so many beads on a string. The arch wires were set to gain expansion where necessary, and the nuts in front of the horizontal buccal tubes were turned back against the latter to obtain lengthening of the dental arches. Under this procedure the anterior teeth were driven forward, these offering the least resistance, just as takes place with the lingual wire and springs acting upon incisors. This, to my mind, is rarely ever desired. The ribbon arch had many shortcomings, which Angle soon discovered, and to overcome which he developed the edgewise arch mechanism.

In presenting this new mechanism Angle particularly called attention to the fact that in all types of malocclusion there was evident not only a tipping forward of the teeth but sometimes a bodily forward displacement. He stated that even in Class II cases this movement had taken place not only in the maxilla, but also in the mandible, and his chief claim for this mechanism was its possibilities for the correction of this condition. The technique of manipulation of the ribbon arch and that of the edgewise arch mechanism are covered fully in the contributions of Brodie, Strang, Steiner and others, as well as those of Angle himself. Of the edgewise arch mechanism, like everything else which has been offered in this, as well as in other scientific fields, there has been some criticism. The efficiency of any mechanism is governed by its performance, in the hands of expert technicians, of the work required of it.

There are still differences of opinion concerning what is normal in the dentocranial relations, and upon this hinges our decision in the choice of an appliance and its application in establishing harmony. If all that is necessary is that we shall broaden the dental arches by tipping the premolars, canines and incisors buccally and labially, just as you would open a fan, or tipping teeth lingually in some instances, then the ordinary expansion arch and the lingual wire with its auxiliary springs are efficient mechanisms. Twenty years ago, or more, it became evident to many of us that this was not all that was required in the majority of cases. The ordinary expansion arch, with its wire ligatures, has infinitely greater possibilities, except for purely buccal expansion, than has the lingual wire. Early in the history of the ribbon arch some operators conceived the idea of substituting a delicate round wire for the ribbon in the commencement of treatment, in order to facilitate tipping of the teeth, thus placing it back on a par with the ordinary expansion arch. This, to my mind, detracted from the efficiency of the ribbon arch appliance. The McCoy open tube, as a means of fixation of a round arch wire to the teeth, is just an improvement over the wire ligatures, and still leaves this appliance a crown-tipping mechanism, and one in which anchorage cannot be established to the best possible advantage. The edgewise arch mechanism has good possibilities. With it one may obtain bodily buccal expansion and, in the hands of those who have become expert in its use, teeth in faulty axial inclination can be corrected, but it is very doubtful if teeth can be carried bodily back with this appliance without the addition of extraoral anchorage. In fact Angle advised the less experienced operators to incorporate with it occipital anchorage. In my opinion this is required in a large percentage of cases, regardless of what type of appliance is

being utilized. The literature contains reports of many cases treated with the various types of appliance, which, to my mind, still present double protrusions, the result of lack of anchorage—the greatest mechanical problem in orthodontics. It would be interesting to have full reports of some of these cases five to ten years after the removal of appliances.

Bite plates have a legitimate place in orthodontic mechanics, but in very many instances are used to spurious purpose. As sometimes applied they act as a camouflaged screen behind which to hide, for a time, an unsuccessful result. Time does not permit now the discussion of this much abused mechanism. Rarely should a bite plate have an inclined bite surface, because this tends to produce a tipping forward of the mandibular incisors, unless there is an efficient appliance upon the mandibular teeth to prevent this undesirable movement. The bite surface should in most cases be flat.

Intermaxillary anchorage, introduced by the late Henry Baker, in the form of elastics, is another principle which has been very much abused in the treatment of cases in Class II.

With my views of what is the normal relation of the dental area to the cranium, the pin appliance, with auxiliary springs, fulfills all our requirements more fully than does any other mechanism we have today for the correction of the large percentage of cases. Possibly some of the cases in which I use this appliance might be as well or better handled with the edgewise arch mechanism by one expert in its use, but I have not had actual experience with this apparatus. I have, however, followed very closely the work of other operators in its use. For ten years now I have been having four premolars removed in quite a number of cases in which I feel that it will never be possible to obtain sufficient growth of the apical base to accommodate the full complement of teeth, and I cannot conceive how any mechanism now in existence can compare with the pin appliance and the U-springs in carrying out treatment where the six anterior teeth must be carried back, most often bodily. It is an efficient appliance in any type of case, provided that the operator possesses reasonable mechanical ability, and its possibilities in the establishment of what I have said is a most important factor—anchorage—are second to none.

From long clinical experience I have come to agree with Sim Wallace that malocclusion is chiefly the result of a forward translation of the teeth, due to lack of backward growth in the main body of the bones. That Hellman is not very far away from this same view is evidenced by his discussion of a paper by Rogers,[3] a portion of which discussion I quote herewith: "I do not understand clearly why Dr. Rogers is looking exclusively for changes in the condyle in the treatment of those cases. Since I have been acquainted with Class II cases, orthodontists have always been talking about changes in the condyle. From studies on growth, it is reasonably clear that as the face grows forward it increases its dimension from the ear hole to the incisor region. Where the increase takes place is less clear. As the dentition develops, the centers of growth of the jaws, and particularly of the alveolar arches, are behind the last molar tooth, whether it is the first deciduous molar, or the second permanent molar. That is, in the maxilla the center of growth is in the tuberosity, and in the

mandible the retromolar triangle. Growth in these centers is actually in a backward direction. The face, however, readjusts itself forward, carrying the teeth in front of the growth centers with it. But as the face adjusts itself forward, there is more growth in the alveolar processes than in the body of the jaw bones; therefore the alveolar processes carrying the dental arches adjust themselves forward more than the rest of the jaw.'' Permit me to call your attention particularly to the last sentence of this quotation: ''But as the face adjusts itself forward, there is more growth in the alveolar processes than in the body of the jaw bones; therefore the alveolar processes carrying the dental arches adjust themselves forward more than the rest of the jaw.'' It is evident from this statement of Hellman that he and I are in agreement that the alveolar processes may be farther forward than the main body of the jaw bones. To all of us, as orthodontists, upon whom is placed the responsibility of correcting these conditions, what real difference does it make whether the advanced position of the alveolar processes is the result of more rapid growth of this area than that of the main body of the jaw bones, as Hellman states, or whether it is due to forward translation of this area, due to lack of normal growth at the back to accommodate the developing molars, as suggested by Sim Wallace, myself and others?

In the average Class II case, particularly of the first division, there can be no doubt but that the maxillary alveolar area is too far forward, and, as Dr. Angle said, not only have the teeth tipped forward, and sometimes moved bodily, in the maxilla, but also in the mandible. It was, doubtless, a realization of this fact which was responsible for his development of the edgewise arch mechanism. Therefore, in the treatment of some cases, at least, it becomes necessary to carry the teeth of both maxilla and mandible back into normal axial relations with the jaw bones *if possible*, and then apply the proper stimulation to obtain the necessary forward growth of the main body of the mandible, which will bring along with it the teeth and their alveolar surroundings to a point where the mesiodistal relations of the jaws will be normal. Now, it is not always possible to obtain the required amount of distal movement of the teeth, and impaction of third molars would almost surely result if we did succeed; thus my reason for the removal of four premolars in some cases. This procedure is still frowned upon by some extremists, and Mershon, in a paper on ''Failures,''[4] refers to it as ''another supposed short cut to early completion of cases,'' and speaks of ''the ruination of many faces by the extraction of teeth as an orthodontic procedure.'' We have all seen many instances in which this has proved to be true, but judicious application of this procedure, followed by skillful adjustment of the remaining teeth, results in an harmonious facial contour which would have been impossible without the removal of teeth. Figs. 6, 7, and 8 show photographs of a young lady, in the attempted correction of whose case several years were wasted in an effort to carry out that ideal plan of Angle, but from whose dental arches we later had four premolars removed. Is there any apparent ''ruination'' of this face as a result of extraction? Several such cases have been reported in the literature. Where definitely indicated, it is not only a short cut but an absolute necessity in establishing stable occlusal relations and facial balance.

In the same communication Mershon condemns retainers, in which I agree with him. He says: "Orthodontists claim that they merely hold the teeth in positions in which they belong. Who of us knows enough of the periods of growth and the directions of growth to know where teeth belong? They belong in positions which they will find eventually for themselves, retainers or no retainers." Mershon's statement in this last sentence is a very significant one, as it indicates that in many treated cases the teeth shift more or less after the removal of retainers; but do "they belong in positions which they will find eventually for themselves"? They shift because, possibly, they are not occupying their normal relation to the apical base, nor is it possible for them, in many instances, to find that normal position without the aid of correct mechanical stimulation. If men with extensive clinical experience have not acquired some knowledge of "the directions of growth to know where teeth belong," what is the use of our trying to carry on in this work? If teeth are placed in their

Fig. 6. Fig. 7. Fig. 8.

normal relation to the apical base, and the jaws are in normal relation to each other and to the cranium, no mechanical retention whatever is necessary after treatment, and there will be very little shifting after the removal of the treatment appliances. As evidence of this statement, I have reported many such cases five to eight years after removal of appliances.

Oppenheim, in "The Crisis in Orthodontia,"[5] says: "Although Mershon has had more than 3,000 cases of his own, only a few of his clinical records are obtainable," and further, "If one analyzes only the more extensive report of Mershon's in which finished cases are shown two to five years after treatment, one finds only very few cases which would fulfill all requirements of the ideal outcome of orthodontic treatment; the mesiodistal relations of the jaws in Class II cases especially present a condition (end-to-end occlusion) which can by no means be considered an ideal end-result and which, according to Angle's diagnosis, would call for further treatment." Oppenheim, on the other hand, in the same communication, says: "The time required for retention must gen-

erally be longer than that for active treatment.'' Oppenheim is a great student of histology, but he, apparently, has not yet learned that there *is* a position in which teeth may, by the exercise of judicious mechanical stimulation, be so placed that they will remain without the aid of splints. If one suffers a fracture of the bones of an arm or a leg, must he wear a splint for years?

There are still extreme differences of opinion concerning both our biologic and our practical problems. Many authorities believe that the jaws are decreasing in size faster than the tooth material is being decreased. As a result of this, in my opinion and that of many others, the teeth are being forced forward of their normal relation to the base and to the cranium. Why do so many orthodontists in directing their procedure in treatment, persist in trying to force Nature to build jaws beyond the requirements of our dentures in the present high state of civilization, in spite of the repeated failures to obtain such growth? We cannot change the trend in growth of the jaws, unless we can force the civilized world back to a diet which will demand the necessary stimulation to produce such growth. So we must compromise, even to the extent, where indicated, of sacrificing some teeth, and direct our treatment to correct any forward displacement of the teeth which may have taken place due to lack of the necessary growth.

To expand the dental arches and carry the incisors forward, with the mistaken idea of stimulating growth, is a very easy thing to do and can be accomplished with the simplest forms of appliances, and with a minimum amount of technical skill. The numerous failures, following this method, should convince us that our problem is not so simple; but many operators, apparently, do not want to turn from this easy going to a procedure which is difficult, and which demands the use of complicated mechanism and higher technical skill in its manipulation. But this must be done if we are going to obtain a larger measure of success.

Hellman, in his efforts to find the truth, is very sincere, as evidenced by a statement which he made in a paper on ''Failures in Orthodontic Treatment,''[6] in which he says: ''Failures due to unfavorable changes which follow successfully treated cases are the most interesting and offer the most fertile field for research in orthodontia. Unfortunately, the material for such studies is not very abundant because sustained interest in what we fail to accomplish is not remunerative. I have made an effort to collect such records, and up to date I have almost as adequate a collection of casts of failures of this nature as I have of successes.'' I should like to discuss one of these failures which he reported, illustrated in Figs. 17 to 22 in that paper. The patient was a boy eleven years of age, presenting a malocclusion of the first division of Class II. The mandibular first molars had been lost, and in the treatment Hellman brought the second mandibular molars into contact with the second premolars. After five years of treatment and retention he said the dentition was ''in normal occlusion,'' but that the maxillary second molars had no antagonists with which to occlude. He retained the case for another year, by which time the maxillary third molars had erupted, and the retainers were removed. Six months later

he made casts, which showed a definite tendency to a relapse to the original Class II condition. At this period he and the boy agreed "that the matter was not quite right." Thirteen years later the boy paid him a friendly visit, when he again made casts, the case now having reverted to the original Class II, first division. Hellman, in comment upon this, says: "Whatever may be the explanation of these last two failures [the one in question and another—brackets mine], the fact remains that both were brought about by growth changes which occurred after the orthodontic job was successfully finished." Now, was this case "successfully finished"? The maxillary first molars were carrying large fillings, and while the photographs of the boy were not shown, there was, naturally, more or less maxillary protrusion, and I feel, as did several of those who discussed the paper, that two maxillary teeth, preferably those with large fillings, should have been removed, the maxillary protrusion corrected, and possibly stimulation provided to obtain more horizontal growth of

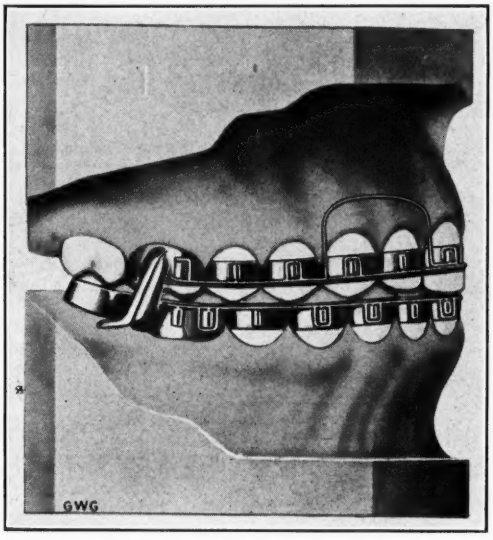


Fig. 9.

the mandible. There is no evident reason, to my mind, why this case might not have been a success, rather than a failure which Hellman ascribed to growth changes taking place after completion of treatment.

As justification for this constructive criticism, permit me to report a somewhat analogous case, in which the removal of three teeth was forced upon us, due to pulp involvement. Unfortunately, the treatment of this case has only recently been completed, so we cannot yet speak positively as to the final outcome; but the literature carries reports of many others, of various types, the treatment of which was carried out in somewhat similar manner, and which did prove to be successful.

The mechanism which I use in these complicated cases is the pin appliance, the arch wire of which is now being constructed entirely by the operator, and should be of 0.032 inch spring wire. U-springs play a very important part, and these should be of the most springy wire obtainable—0.023 inch in diameter.

The U-springs, with a half-round pin attached, will enable the operator to obtain bodily movement, rotation and intrusion. In different forms, without the pin, we may obtain tipping. Most, if not all, of the teeth are eventually banded, and carry half-round vertical tubes, usually 0.10 inch long. The tubes are placed parallel to the long axis of the teeth and in the center of the buccal (or labial) surface in such a position as to allow sufficient of the band material upon which the arch wire may rest. There is thus no exposed enamel which cannot be perfectly cleansed by the toothbrush. The tubes for the molars are of the diameter ordinarily used for the lingual wire, and those for the other teeth are much smaller. Fig. 9 shows a complete appliance, including the buccal planes which were advocated by me in a paper at the Atlanta meeting of the American Society of Orthodontists eleven years ago, details for the construction and application of which have been published in former papers. These planes are applied only in those cases requiring stimulation to obtain horizontal growth of the mandible. In order to stabilize the anchorage more fully, I have for some time now been placing two 0.08 inch tubes upon at least the first molars, as shown upon the mandibular first molar in this illustration. The locks are of soft wire, as advocated by our beloved confrere, the late J. Lowe Young. Those for the molars are made from 0.025 inch wire, soldered only at one end; the others from 0.018 inch wire, attached to the arch wire at both ends. A change from the three-piece arch to that of one piece, with vertical tubes, in place of horizontal ones, upon the molars, was also developed by Young. The small half-round tubes, for use upon all teeth other than the molars, was originally suggested by another much-loved confrere, the late Chas. A. Hawley. The original pin and tube appliance was the product of that genius for mechanics, the late Edward H. Angle, who did much to advance the science of orthodontics.

This case was chosen for discussion here because it presented complications in tooth movement which would demand maximum efficiency of an appliance under difficult conditions, and would give an opportunity to explain in detail the technique for obtaining the varied movements of individual teeth, as well as the stabilization of that most important factor—anchorage. Fig. 10 shows the original casts of the patient, a youth sixteen years of age. His dentist stated that both mandibular first molars and the maxillary left first molar would have to be removed because of pulp involvement. The overbite was 9 mm., the maxillary deciduous canines were still present and the permanent ones situated in rather undesirable positions, as shown in Fig. 11. According to Angle's classification, the case belongs to Class II, second division, and the photographs of the patient, as seen in Fig. 12, show a short mandible. Because of the impaction of the maxillary canines, and the necessity for the removal of three molars, the case supplied a fascinating opportunity to ascertain what was possible in orthodontic mechanics. All third molars were present, but unerupted; so to establish balance somewhat in the extractions, the maxillary right second premolar was removed, as were also the maxillary deciduous canines. We thus had an opportunity to make space for the impacted canines and room to carry back the maxillary incisors, which were somewhat protruded, particularly at their root ends.

Bands were placed upon all the remaining erupted teeth and pins on the arch wires for all these except the premolars. U-springs, with pins, were adjusted to the maxillary right first premolar, the second having been removed, and to all the other second premolars, to carry these four teeth distally. The other three first premolars were left free to follow the movement of the premolars

Fig. 10.

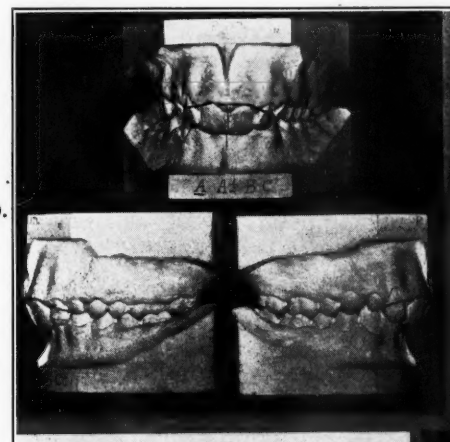


Fig. 11.

Fig. 12.

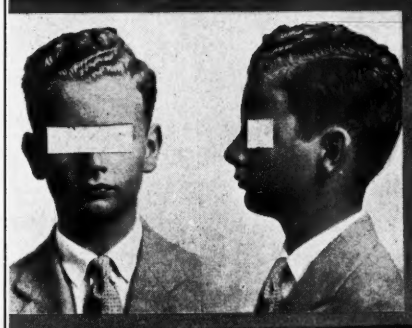
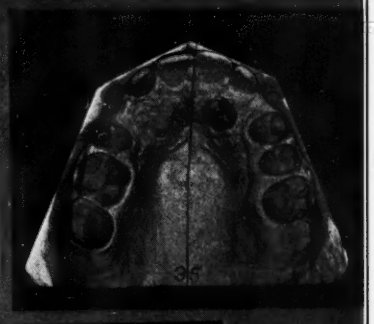


Fig. 13.



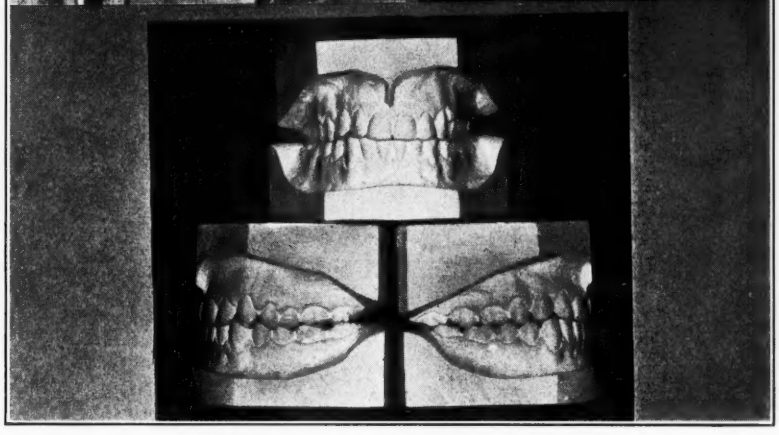


Fig. 14.

being moved by the springs. The balance of the teeth, being attached to the arch wires, established all the intraoral anchorage available. To this was added occipital anchorage, to be worn as much as possible. When the maxillary right first premolar and the second left premolar were as far back as was desired, pins were placed upon the arch wire for these teeth, a spring was attached to the left first premolar, and we were ready to uncover the maxillary right canine.

The incision was made immediately in contact with the palatine surface of the teeth, and extended mesially and distally for some distance from the canine area. The soft tissue of the palate, including the periosteum, was turned well back and the bone overlying the canine was cut away just sufficient to expose its crown and enough of its mesial surface to make space for a light spring to rest against it and start its movement lingually and distally. The soft tissue was now turned back to place and sutured through the interspaces to the buccal in several places. A sufficient portion of the soft tissue was now cut entirely away to expose the crown of the canine. This hole was packed with temporary stopping, and a wire spring from the arch wire was fitted to hold the tent in place. In a few days the tent was removed and an additional spring was fitted against the mesial surface of the tooth to bring about its movement. The temporary stopping was replaced upon each adjustment of the spring, in order to prevent the closing in of the gum tissue. The tooth tipped very readily, and it was soon possible to do away with the tent. When the maxillary left first premolar was back in contact with the second, the left canine was similarly exposed and its movement started in the same manner. Fig. 13 shows a later palatal view, with both canines carrying bands upon which were soldered the regulation half-round vertical tubes, to which we fitted springs from the arch wire to bring the roots of these teeth forward and obtain any other desired movement. With properly adjusted springs the teeth were under absolute control, which is the beauty of this method of obtaining individual tooth movement. When the canines were in normal position, they were attached to the arch wire by means of pins in the regular way, and the intrusion and lingual movement of the lateral incisors was commenced, and later the central incisors in the same manner. The roots of these incisors stood labially too far before treatment was commenced, and the whole premaxilla had dropped down too far, to the extent almost of the length of the crowns of the teeth. Later, steep incisor planes were placed to assist in the intrusion of both maxillary and mandibular incisors and at the same time to stimulate forward growth of the mandible. These planes were worn for one year. The adjustment of the mandibular teeth was being obtained simultaneously by similar technique. The movement of the mandibular teeth was completed much ahead of that of the maxillary teeth, and the mandibular appliance was off for a year, but had to be replaced for a time because of just the slightest crowding and a little elongation of incisors because the maxillary incisors were not yet back in contact with them. All appliances were off for one summer while the lad was abroad, but during this time a maxillary plate, with flat bite surface, was worn.

The patient had planned to go to England this summer for an extended period, and when the time arrived for his departure the maxillary incisors were not yet intruded quite far enough, particularly on the left, nor were the central incisor roots perfectly parallel with the sagittal plane; nevertheless all appliances were removed, and Fig. 14 shows the teeth at this time. The overbite, at its greatest depth, was now just about 2 mm. All will realize that a little congestion of the gum tissue shown in a couple of places will clear up very quickly after removal of appliances, and also that the buccal teeth will settle down into

better occlusion. No retainer was placed, and, although I did not have sufficient time to complete quite all desired movement, I feel the case will not fall down very much. Unfortunately, photographs were not obtained, as I had not anticipated reporting this case until it was put to the test of time; however the facial lines were much improved. The true test of our results is the condition of the dental arches at least three to five years after the removal of all appliances. Some of my cases, completed about ten years ago, and upon which no retainers were used, were reported[7] at the meeting of the American Society of Orthodontists in St. Louis in April, 1936. I feel that these cases, along with others reported previously, present evidence that retaining appliances are not necessary if our cases are properly corrected; nor do the teeth shift unduly after completion of treatment, for which lapse some of us are prone to blame conditions supposedly beyond our control.

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12 BLOOR STREET EAST

ORTHODONTIC SUPPOSITIONS

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IN THIS paper I shall attempt to consider what I have called Orthodontic Suppositions, and by that is not meant orthodontic theories. There are not many well-established orthodontic theories, but we do act on a good many suppositions. A theory in the scientific sense is a conclusion accepted provisionally, but only after it is shown to be compatible with all the known facts. One thoroughly established fact that cannot be harmonized with a theory either renders the theory obsolete or makes necessary its modification. In the scientific world no generalization achieves the status of a theory until it has run the gauntlet of the closest possible scrutiny. Many of the dicta that have profoundly influenced orthodontic thought and practice have not begun to reach this level. When new ideas have been advanced, our profession has not consistently applied the rigid criteria that science demands.

It is true that we are constantly called upon to deal with conditions the origin and development of which we do not understand, and experience has shown that in many of these cases certain procedures are likely to be successful. The application of such procedures under such circumstances constitutes empirical practice, and while it is frankly a makeshift made necessary by our ignorance, empirical practice has its legitimate and useful place. Patients come to us with dental conditions that limit their usefulness or compromise their happiness. If we should wait in all these cases until we had a complete etiologic picture and full assurance of the efficacy of our treatment, many persons would go uncared for whom we can really help.

What often happens is that the orthodontist does not realize that his procedure is empirical. Some one thinks out or stumbles upon a procedure, an appliance, a classification or what not that yields a satisfactory outcome in a few cases. At this stage he too often dreams of universality of application. He may even think that he has solved the orthodontic problem, so he begins to rationalize his procedure, seeking a scientific and philosophic foundation for his course of action. Unfortunately the chances are that he has not had the fundamental training that is essential where evidence is to be weighed objectively. His enthusiasm is apt to run away with his judgment: he becomes an advocate of his idea instead of an impartial investigator of its truth, and so his conclusions are of little worth. His followers are not likely to be more critical than he is, but accept his conclusions at their face value. The foregoing has been pointed out many times in recent years, and there are beginning to be signs of encouragement. More men are taking a realistic view of our field and its problems and are being swayed less by wishful thinking. Nevertheless the present state of our literature and the prevailing atmosphere of

Read before the Great Lakes Association of Orthodontists, Toronto, October, 1936.

our gatherings make it imperative that we continue to remind ourselves frequently that the bulk of our treatment is empirical. With this realization clearly before us there is hope for advance.

Due to our training (and it is a comment on our training) we suffer a constitutional disinclination to consider any proposition seriously that does not promise finality of result. Although we are beginning to tell each other that ours is in essence a biological problem, we have yet to learn that finality is a word very little used by the biologist. One reason for our attitude is that finality has been the dream of orthodontics for the past third of a century, and it seems very difficult to shake off the spell. Kemple said recently that, "It is unfortunate for orthodontia that (Angle) was not scientifically minded."[1] It is true his contribution was very great, but it would have been much greater if his remarkable energy and idealism had been directed by a mind trained to "the scientific habit of thought." He had the rare gift of firing his followers with his own enthusiasm but with this went his insistence on their acceptance of certain doctrines not as ideas to be held tentatively and put to the test, but as truths to be cherished unquestioningly. Thus the power of self-criticism was not encouraged among what proved to be a relatively large and influential group, and it took a long time to demonstrate that the unsatisfactory end-results that were inevitable were not all due to poor technic or to lack of cooperation on the part of the patient. This widespread disposition to reserve interest chiefly for those ideas that promise a complete and usually comparatively simple solution to our problems betrays not only a rather naïve conception of nature's processes but also renders us peculiarly susceptible to exploitation that is honest enough in intent and that comes for the most part from within our own ranks.

An example may serve to clarify this. Let us consider the perennial demand that arch form and tooth relationship and hence tooth movement, be put firmly on a foundation that will eliminate guesswork. Even when teeth are moved into positions that satisfy the best judgment of the most exacting operator, a certain proportion of cases shows a distressing tendency to revert to the original position or to develop new tooth arrangements that were unlooked for. The advantage of avoiding this is obvious. If we knew the tooth positions and relations that nature would tolerate and maintain in the individual, our problem would be well on the way to solution. The answer to this riddle has been diligently sought for years. Hawley[2] tried to establish a correlation between tooth dimensions and the size and form of the arch, and was convinced that he had demonstrated this. Hanau,[3] Fish,[4] Stanton,[5] and others elaborated this idea, and Simon[6] extended the anatomic area still further.

One factor common to all these endeavors is the supposition that by examining the morphology of a large number of persons a mean can be evoked that when applied to the individual will prove to be physiologically valid; in other words, that a statistical normal, as it has been called, is synonymous with the individual normal which is in large measure functional. This has not yet been proved to be the case, and there are cogent reasons to suspect that it never can be. It seems to overlook variation and also the fact that nature

does not appear to grow organisms along lines of precise mathematical symmetry. It forgets diversity of physiology and diversity of growth in different individuals. It forgets that in medicine as in biology the individual normal is the significant one.[7]

Last year many of us listened to two warnings along this line. Franz Boas was discussing growth, and while he exhibited facts and conclusions obtained by studying masses of individuals he cautioned that, "Obviously not all children grow according to the standards obtained by the so-called generalizing method, but some will grow much, others little; some will mature early, others late. Their growth depends upon many circumstances: heredity, environment, health, and nutrition, to name a few determining conditions."[8] And apropos of the dental demand for precision and finality Hrdlička told us that, "The intensive desire on the part of the orthodontists to find immutable points on the jaws, face or head, from which to take the measurements they are in need of, is but natural. If such points could be had, it would help greatly. That is why many cling so tenaciously to Simon or any other authority who advocates some definite landmarks. Regrettably such strivings are futile. There are no fixed points, except in the average obtained on a large series of individuals. Every one of the landmarks that ever was or could yet be advocated is subject to precisely the same phenomenon of normal variation." . . .[9] In the light of our present knowledge we shall have to conclude that the idea that from statistics we can produce a standard that will tell us with precision what is normal for the individual has a long way to go before it can reach the rank of a theory in the scientific sense. We shall think of it more accurately as a supposition, and many of us will regard it as a dangerous supposition.

A notion of long standing among us is that the chief influence at work directing the development and maintaining the form of the dental apparatus is force—definite stresses originating in the muscles for the most part and either applied directly through pressure of these muscles against the teeth as, for example, that of the masseter, lip muscles and tongue, or indirectly during occlusal contact through the action of the so-called muscles of mastication. There is evidence to support the idea that the shape of the dental arch is in part influenced by a balance of ponderable forces; tongue, cheeks and lips within and without, occlusal contact, proximal contact and the rest of the familiar list. One may question the wisdom, however, of introducing students to the problem of the development of arch form and tooth position by listing half a dozen definite discrete "forces of occlusion"[10] as the controlling influences in this most complex process, with the risk of creating the impression that such an analysis exhausts the factors responsible. It smacks of oversimplification and invites closer scrutiny. It is an unusual approach to the problem of form and perhaps a characteristically dental approach. It recalls the insistence on the necessity for exercise beginning with suckling at the breast and going on to the chewing of hard foods in order to insure well-developed jaws.

That this list of the forces of occlusion should include cell metabolism suggests the inversion of thought that may be brought about when the

problem of growth is approached from the standpoint of gross mechanics. Whatever cell metabolism may mean, and its meaning will shift from day to day with the advance of biological knowledge, at least it connotes subtle processes of infinite complexity, including those responsible for the little understood growth impulses that finally give rise to the form of the organ or part. In time, as a result of this same cell metabolism, we have muscles and bones which working together produce the type of "forces" that can be felt and measured and that would appeal to one whose training is largely mechanical. When these forces are marshaled and cell metabolism is made one of the list, one has an uneasy feeling that the item classified has overflowed the classification: the part in this instance is greater than the whole. Some one has said that, "All these systems (of classification) have a certain value and are interesting as throwing light on the views of those who invented them."[11]

Students, so far as I know, are not taught primarily the forces that control the shape of the eye or the pelvis or the hand, and yet these structures appear to maintain their form at least as consistently as the dental arches. Forces of one sort or another are doubtless at work within and upon them, but they are not visualized with the simplicity and finality that so many dental writers employ when dealing with the teeth. The effort to simplify what is complex is praiseworthy and helpful so long as the result is not a specious simplification, but one should approach all such attempts with an open mind. Where many of our confreres have not hesitated to rush in with a ready solution or a confident explanation, those who are best qualified tread warily. D'Arcy Thompson, who describes his classic treatise on *Growth and Form* as merely a preface to the subject, says toward the end of the book "for my part I readily confess that I lack the requisite knowledge for even an elementary discussion of the form of a fish or of a bird."[12]

The idea that force is the dominant factor in shaping the arch is attractive to the dentist because it marches with his clinical experience. He can alter the form of the arch more or less successfully by means of appliances. He sees the jaws and teeth enveloped by muscles which he knows to be physiologically engines for the application of force. He also knows that form and function are interrelated. The most obvious function of the jaws is that of mastication. Therefore the relatively powerful muscles of mastication must very largely control the form of the jaws. From this it is but a short step and apparently a logical one to the conclusion that if we can direct or increase the action of these muscles, we can control dental arch form. There is no doubt that many students carry the idea into early practice that by the use of appliances and by the employment of appropriate exercises they possess the key to arch form. As they gain experience they are apt to ascribe the disappointments that are bound to come to lack of technical skill or failure of the patient to persevere with the prescribed regime rather than to any fallacy inherent in this general thesis. It is well to remember that there is danger in building up a logical structure in the biological field unless each successive step is verified by observation, and checked by experiment

where possible. There is always the possibility that factors that have been overlooked or that are altogether unknown may be at work.

There are two procedures that are quite widely employed today that may be examined briefly in the light of the foregoing. One seeks to enlarge the deciduous arch by means of appliances and thus insure the natural eruption and regular relationship of the permanent teeth; the other would develop the muscles of the face and jaws by means of exercises, having in mind the same general objective.

Before deciding to adopt the first procedure one would naturally look for reasonable assurance that it rests on a sound biological foundation, or failing this that as an empirical measure it has been proved effective. To prove its effectiveness it would not be convincing simply to show crowded deciduous or mixed dentitions that had been treated. Too many observers, Hatfield,[13] Hellman[14] and others, have reported cases in which crowded deciduous and mixed dentitions have gone forward to satisfactory development without mechanical interference, and this is becoming a common experience with those who have learned that observation is an important part of orthodontic practice. Thus the case that has had the deciduous arch widened and shows a regular permanent tooth arrangement is always open to the suspicion that a similar end-result might have been arrived at without treatment. To place such a procedure on a sound footing one would have to show by analysis of a large number of similar cases, part of which were treated and part of which were untreated and thus furnished controls for the experiment, that the treated cases showed a sufficiently higher percentage of satisfactory end-results compared with the untreated cases to justify subjecting all such children to a mechanical widening of their deciduous arches. Until this evidence is forthcoming, the need for the employment of the procedure naturally remains in the category of supposition.

So much for the evidence necessary before we adopt the widening of the deciduous arch on the basis of a frank empiricism. The search for a biological mandate for such treatment is another matter. Thirty years ago one of our leading authorities wrote as follows: "In regard to the question of widening the arch when the temporary teeth are in position, I have no doubt that if the temporary molars of a child seven or eight years old are carried out the crowns of the bicuspids go with them, because they are at that time set down between the roots of the temporary molars, which are not yet absorbed, and, in doing this, their eruption into proper position is made almost certain."[2] And he continues that "The effect upon the nasal passages must be beneficial." That is a very precise and definite statement of the result to be achieved based on an equally definite and very simple mechanical explanation of the problem and the process advocated. Has that feeling of certainty been maintained during the intervening years? Have cases so treated been immune from the necessity for further treatment when the permanent teeth have once erupted? The subsequent history of orthodontics furnishes an answer to these questions. It would have been very different had this hope materialized. The fact is that the development of the jaws is not the simple matter it was then supposed to be, and accumulating evidence does not point to the teeth

manipulated or otherwise as the only, or even the chief, factor in such development. On this point the words of Brash used in a parallel connection merit attention. Speaking of the effect of the congenital absence of teeth on jaw form he concludes that "We must agree with the thesis put forward by A. F. Lundström, that occlusional conditions are unable either mechanically or by means of function to alter the size or form of what he calls the 'apical base'; in other words, that the apical base controls occlusion and not occlusion the apical base."

Regarding the second procedure mentioned, viz., muscle training so called, it is fair to make a distinction at the outset. Two ideas appear to be more or less closely associated in the minds of many who are directing children to exercise the muscles of the face and jaws. The first idea is that by this means they may move teeth or help to maintain them when they have been moved by appliances. It seems reasonable to suppose, e.g., that if maxillary incisors that are labially prominent have been moved back to their typical position they will have a better chance of staying there if the lips are kept closed than if the child continues habitually to keep the lips parted, and some are convinced that such closure may be encouraged and the tone of the muscles of the lips improved by suggesting certain exercises. How far this idea can be extended so that the muscles are consciously employed as "living orthodontic appliances," as they have been called, is very much an open question. Those who have been observing children for years and have seen many cases improve without mechanical treatment or any other interference will naturally be more cautious in arriving at a conclusion than those who have formed the habit of placing appliances immediately in almost all cases, and then viewing all subsequent changes as having been brought about by their action.

The second idea associated with the employment of muscle exercises is that growth of bone can be initiated by the stimulus of muscle pull. One can say very definitely that this is yet to be proved. Because children have been given exercises to do and their jaws have grown does not mean necessarily that the exercises were the cause of the growth. "Growth as a physiological process is dependent upon some deep, inherent characteristic of living protoplasm at present unknown. It is aptly described as 'the growth impulse.' An abundance of food and an adequate supply of vitamins provide the essentials for growth."[15] After a very full analysis of the evidence Brash says, "Whatever may be the ultimate verdict on the nature of the relation between function and the form of bones, it can certainly not be maintained that we yet know enough about that relation to explain with confidence anomalous forms of jaws and associated malocclusions on the basis of 'lack of function' or 'perverted function,' "[11] and speaking of facial muscle exercises as at present advocated he concludes, in line with the distinction cited above, that "The value of such exercises in overcoming undesirable 'occlusional habits,' and as an adjuvant to the use of appliances in regulation, may possibly be great and is for technical experts to assess; but it cannot be admitted that there is any proved etiological ground for supposing that they can affect the growth or the form of the jaws."[11]

A supposition of a different order and one that tends to limit our usefulness is that proper orthodontic service can be rendered only through the use of complex appliances and the application of a very exacting technic. A recent textbook[16] takes this attitude. The author assesses the suitability of the various appliances in present use. The only one he finds acceptable in the light of the criteria he applies is one that was designed to control with precision the movement of every individual tooth and that calls for a most exacting technic in its construction and manipulation. This conclusion on the part of the author has at least two important implications. First, it takes for granted that the operator's knowledge of the physiologic milieu of the teeth is so complete that he can decide with confidence the precise position of each individual tooth with the assurance that the validity of his judgment will be upheld by nature. That is taking a very great deal for granted. Second, it places orthodontics beyond the reach of all but a paltry fraction of those who need it. In a recent paper in which he discusses our specialty from the socio-economic angle, Moore says that "Increased demands are most certainly going to be made on the orthodontist. His exacting methods of the past need not become extinct, but, in order to enter into true social service, simplified and minimized treatment must become the rule."[17]

These are examples only of suppositions that are prevalent. Perhaps they are among the more excusable ones. They at least embody ideals of achievement. If time permitted we might discuss others, such as the persistent retention of "mouth-breathing" as a definite "cause" of malocclusion, which in view of the analysis of growth of the face made years ago by Keith and Campion,[18] the more recent assessment of the literature by Brash[11] and the subsequent statistical data furnished by Howard,[19] implies ignorance of the progress of criticism on this point: the supposition that all cases that are not treated will grow worse, which reveals the paucity of observation of growth processes on the part of those who still cling to this point of view: the supposition that orthodontics is primarily a matter of moving teeth which appears to have the approval of the American Association of Dental Schools if we are to judge by the effect that will surely be produced on the mind of the student by the course on orthodontics as outlined in the Curriculum Survey Report published by that body.[20, 21]

In an article considering the future of a great university, Professor Whitehead has pointed out recently that the history of thought from the time of Plato to the present is in the first place the story of the attempts that have been made to classify knowledge on the basis of what is surely known and what is only probably true. So it becomes "largely concerned with the records of clear-headed men insisting that they at last have discovered some clear, adequately expressed, indubitable truths."[22] Of course these indubitable truths never prove to be final and so the quest goes on. To say that this process is likely to continue to be a process rather than to arrive at a definite goal is simply to note once more the limitations of our mental processes and the infinite complexity of the manifestations of nature, but it does not lessen the necessity of persisting in the effort if we are to avoid stagnation. Professor

Whitehead says, "Every single generalization respecting mathematical physics, which I was taught at the University of Cambridge during my student period from the years 1880 to 1885, has now been abandoned in the sense in which it was then held. The words are retained, but with different meanings." A like process is a vital necessity in our own field and is being fostered diligently by a few. The progress may seem slow but it is encouragingly steady. We can help this trend by constantly trying to distinguish supposition from theory and theory from fact; by cultivating an atmosphere of reality and objectivity as we go about our work, by refusing to fool ourselves as to the basis for our actions. If, lacking fundamental knowledge, we undertake a treatment on an empirical basis, let us recognize it as such, rather than attempting to justify it on spurious grounds of pseudoscience. To consciously distinguish what we know from what we do not know is often difficult, but it is fundamental. Only in such an atmosphere will research flourish and consistent progress be possible.

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DISCUSSION

Dr. Samuel J. Lewis, Detroit.—My most important comment upon this excellent paper is that the orthodontist can only agree with the point of view it represents and accepts its conclusions. No orthodontist who examines the basis of his practice can doubt that it is almost wholly empirical. It is certain also, as Dr. Woodbury states, that the profession has been too ready to accept the unproved dicta of early leaders. I would use an even stronger term than "suppositions" and say that orthodontia has placed too much faith in dogma and creed.

At the same time, we should perhaps be sure that we do not misunderstand what is meant by empiricism. It means practice based upon practical experience, unproved by scientific investigation; it is not synonymous with quackery, as is sometimes assumed.

We have, as Dr. Woodbury says, reached the stage where we are able to realize that mechanical theories and technics are inadequate; we are ready to leave the realm of mechanics and enter the realm of biology. We have gone far enough to realize that what once appeared comparatively simple is in reality exceedingly complex.

I am entirely in agreement with Dr. Woodbury's doubts about the value to us of the "statistical normal," even when supplemented by data on a range of individual variations. To the orthodontist, who is concerned with the individual case, the mass curve plus standard deviation, which shows only major trends, is of little value. I do think, however, that we have much to learn about the unanswered questions of growth from a study of the growth curves of individual children, and from a comparison of the minor variations as between these individual curves.

I concur in the opinion that we have as yet no definite evidence that would enable us in all types of cases to distinguish between those which, improving under treatment, would have shown, merely as a result of developmental processes, a similar improvement without treatment. However, it is my opinion, based upon thirteen years of observation of untreated cases, that there are certain definite types of cases in which there is no possibility of a normal occlusion's being reached unless treatment is given.

There is hope and encouragement to be found, as Dr. Woodbury says, in the growing realization that orthodontic practice must be based upon knowledge and observation of biologic processes. It appears to me, however, that at present many orthodontists who have advanced to the point of believing in the use of "observational methods" are not possessed of a sufficient knowledge of growth processes to enable them to understand what is going on and to proceed on the basis of such understanding.

In conclusion, let us not be content merely with a passive agreement with the points put forth in this admirable paper. If it is to have the effect it deserves, it should urge upon each of us individually the necessity of taking stock of our orthodontic theories and the practice we base upon them, and of raising both to the highest level possible in the present state of knowledge relevant to the profession.

ORTHODONTICS IN SANTA CLARA COUNTY UNDER THE CRIPPLED CHILDREN'S ACT*

WILL GROSS SHEFFER, D.D.S., F.A.C.D., F.I.C.D., SAN JOSE, CALIF.

SINCE 1929, a limited number of handicapped children in Santa Clara County have received orthodontic treatment under the Crippled Children's Act.[1]

Like every other community in the United States, Santa Clara County has its share of the 15 to 25 million children[2] needing orthodontic treatment.[3] As in almost every other city in the country, San Jose orthodontists are treating only about 2 per cent of the number of children in need of orthodontic treatment.

Santa Clara County has no county dental clinic. San Jose, a city boasting of a population of over eighty-six thousand, has no dental clinic; therefore dentistry and orthodontics for indigents are being administered in the offices of private practitioners.

Every orthodontist, like every dentist, is doing his share of treating indigent patients without receiving remuneration. Frequently patients are accepted as charity patients at the beginning of treatment. Often treatment is continued when supposedly good-pay patients become so economically situated that further reimbursement to the orthodontist is impossible. We as orthodontists feel it our moral obligation to help these unfortunate families by continuing the treatment of the children's dentofacial deformities. But when a state or a county or an institution with ample funds with which to pay for the services of a specialist, asks that orthodontic treatment be given handicapped children, and a law provides for the disbursement of funds for the treatment of such handicapped children, it is only reasonable to assume that orthodontic fees be commensurate with the type of service rendered.

On this assumption in 1929 the first patient to receive orthodontic treatment under the Crippled Children's Act was accepted for treatment. The child's dentofacial deformity was extreme. Every one seeing the girl exclaimed, "Something should be done about her handicap!" (Fig. 1.)

Orthodontic appliances gradually but surely changed the patient from a "frightened little waif," to a healthy looking child with friendly personality. The splendid results attained were due in part to the patient's having been placed in the County Preventorium where regular hours, excellent health surroundings, proper diet and cooperation in wearing the appliances brought gratifying results (Fig. 2).

The good news traveled fast, and soon all who saw the improvement in Case No. 1 sought orthodontic treatment under the Crippled Children's Act for other handicapped children.

*Read at the Seventeenth meeting of the Pacific Coast Society of Orthodontists, Feb. 23, 1937, San Francisco.

Treatment was begun on several children who had most extreme dentofacial deformities. Soon more children applied for treatment than the State Board of Health thought should be treated in the offices of private practitioners. Therefore in 1931 children receiving certification under the Crippled Children's Act were assigned to the University of California Orthodontic Clinic for treatment. One year later it was found that, while the clinic fees were nominal enough, railroad fare for patient and parent or guardian to and from the Medical Center amounted to more than the fees of the local orthodontists.

After a discussion of fees for treatment of these State Aid children, it was agreed by five orthodontists of the county that a 25 per cent reduction be given the state for this type of orthodontic treatment, thereby reducing the fee per year to just a little above the cost of handling each case. All but one of the orthodontists in the county agreed that a yearly fee be charged for orthodontic treatment under the Crippled Children's Act.

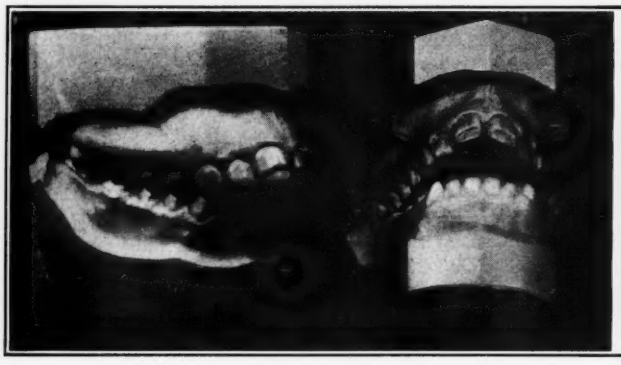

Fig. 1.

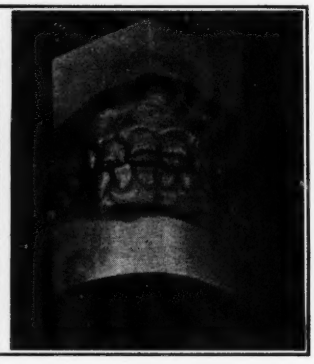

Fig. 2.

Parents and nurses continued to apply for certification of children having severe dentofacial deformities. At first there was a strict and lengthy procedure in obtaining certification for orthodontic treatment under the Crippled Children's Act. Complete gnathostatic investigations were made of each case. A letter advising that certification be granted and giving a diagnosis was sent to the attorney handling these applicants. The parents and the patient were then interviewed by a judge and two county supervisors. One patient having a most extreme type of deformity, with only the distal of the second molars in occlusion, was refused certification for orthodontic treatment because the judge thought the patient looked plump. Upon certification, a case was then referred to the State Board of Health. The orthodontist in turn was asked for a diagnosis, prognosis and estimate of fees. Assignment of the patient to the orthodontist for treatment was then made. Models, charts and photographs were sent to the office of the State Board of Health as records. Follow-up models, etc., were sent showing the progress of each case. Finished models, charts and photographs were sent at the termination of treatment.

Treatment continued until the maximum correction advisable or possible was obtained. In some instances retention appliances were placed in less than

a year. Others required longer periods of treatment. But in every case the patient returned for years, for check-up during retention or for retreatment

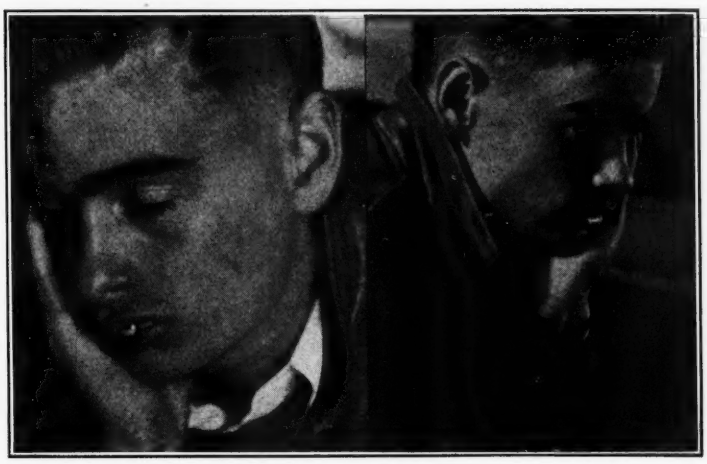

Fig. 3.

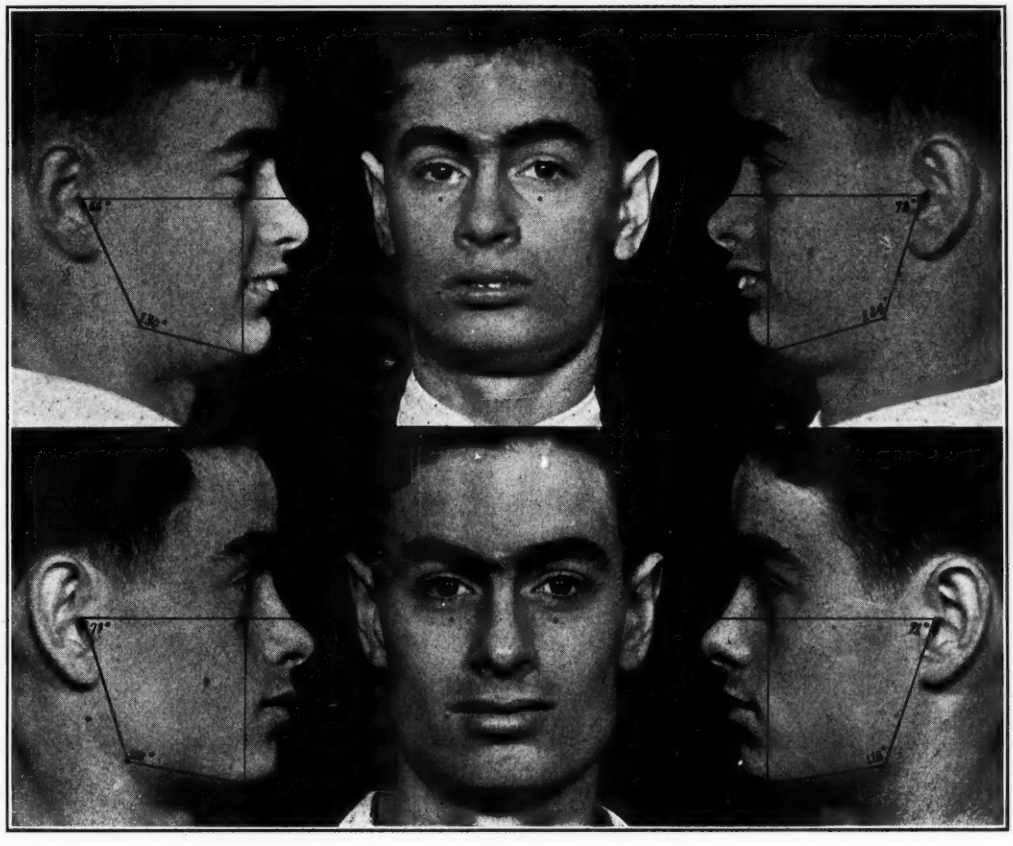

Fig. 4.

after financial responsibilities of the state had been concluded. Some patients came to the offices of the orthodontists for adjustment of their appliances as many as sixty times a year.

One has but to look at the seriousness of these handicapped mouths to realize that complete correction was impossible. In some instances the removal of bicuspids shortened the period of treatment considerably. In most cases the children were undernourished and offered only fair cooperation in wearing the appliances and in promoting mouth cleanliness. Several had conflicting posture habits retarding the action of the appliances. In all cases except one in which no cooperation at all could be obtained, the results have been well worth the time, money and effort invested. (Figs. 3-6.)

In the past two years, only one new case was certificated for orthodontic treatment in Santa Clara County under the Crippled Children's Act. The

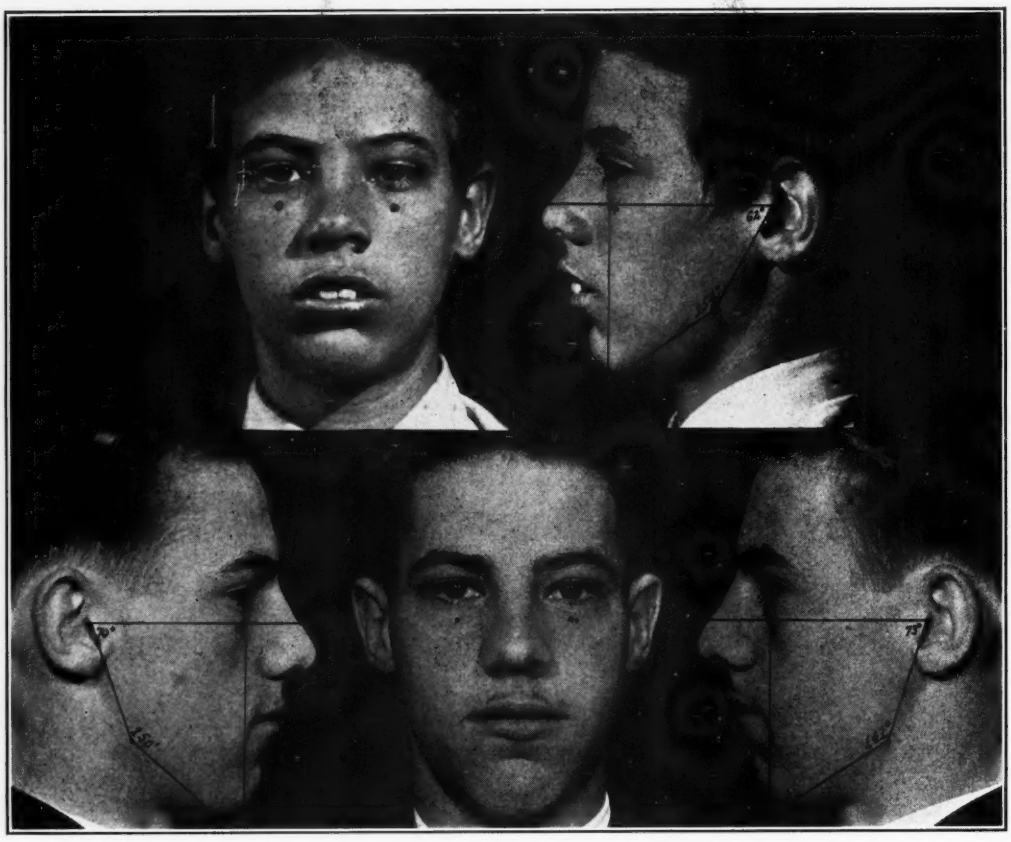

Fig. 5.

number of cases certificated for treatment seemed to reach a point of saturation when the medical director thought that enough county medical funds had been used for orthodontic treatment, and when the orthodontists felt that enough of these low-pay indigent cases had been imposed upon their private practices. However, over two hundred children with dentofacial deformities were examined and advised to see the county health officer for certification. One orthodontist alone has spent enough hours examining these applicants in the last two years to equal an entire month's office time. At first, complete gnathostatic investigations were made and letters written describing the deformities. Later only letters were written. Still later, only inspections were

made and the applicants advised to apply directly to the county health officer for certification. Those who had received State Aid orthodontic treatment were so sincerely grateful, and the schoolteachers and county nurses were so enthusiastic about the results that, in spite of the refusals of certification, the parents continued to apply for orthodontic treatment for their children.

Recently federal funds for orthodontic treatment, matched by county funds, have become available under the Social Security Act. To those awaiting certification hope was revived. Some had waited three years for certification, their mouths becoming more and more deformed.

Early in 1937 the orthodontists of the county were informed that lower fees would be paid for further treatment of indigents. Because an exceptionally low fee per case had been secured from an orthodontist in San Francisco for similar treatment, Santa Clara County orthodontists were told that they should expect to receive an even lower fee per case.

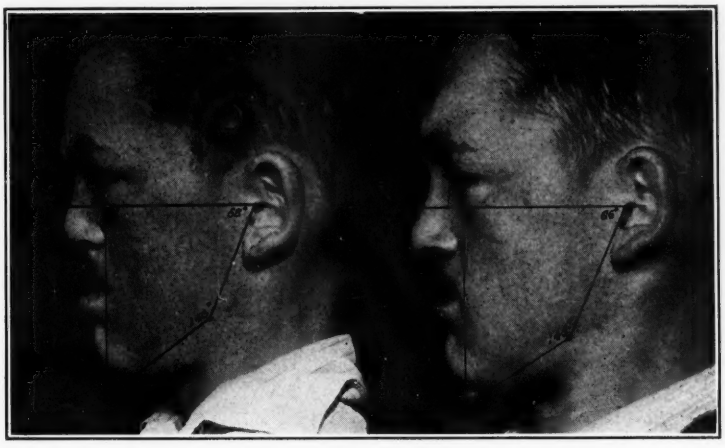

Fig. 6.

The majority of the orthodontists of Santa Clara County believe that most Pacific Coast orthodontists prefer a yearly fee for this type of treatment. The consensus of opinion is that a fixed fee implies a finished case. Most of the cases of this type cannot be finished. Therefore a fixed fee basis is inapplicable to such orthodontic treatment under the Social Security Act.

A request was made by the orthodontists of the county that the yearly fee basis be continued. Remuneration for the treatment of orthodontic cases assigned in February, 1937, by the State Board of Health, is arranged on a yearly fee basis sliding downward in amount until the fee for the third year of treatment is less than the proverbial five dollar a month rate.

Thus in the last few years, the orthodontists of Santa Clara County have seen the persistent lowering of fees for treatment under the Crippled Children's Act and an attempt at bargaining for lower fixed fees per case for orthodontic treatment under the Social Security Act.

Organized criticism of the expenditure of public funds has produced fantastic stories of exorbitant fees paid orthodontists. The continual reduction

of fees for treatment and the fact that the cases selected for treatment are most difficult and sometimes undesirable make it advisable for orthodontists to accept only a limited number of such indigent patients for treatment.

Santa Clara County has not solved the problem of how to provide orthodontic treatment for its indigent children having dentofacial deformities. In the eight years of orthodontic treatment in Santa Clara County, under the Crippled Children's Act, only 0.001 per cent of those children needing correction of their handicaps have been granted certification. Only once has a systematic method of clinical examination attended by both physicians and orthodontists been made in Santa Clara County. Los Angeles County[4] has more effectively solved this problem by having a board of both physicians and orthodontists determine the fitness of the patient to receive orthodontic treatment under State Aid.

A satisfactory way of determining the fitness of the indigent patient to receive treatment was employed in a recent orthodontic examination of children applying for State Aid in Santa Clara County. Patients were classified as follows:

A. Those having malocclusions but not severe enough to warrant the expenditure of County, State or Federal funds.

B. Those having serious dentofacial deformities but not needing immediate treatment.

C. Those having extreme dentofacial deformities needing immediate treatment.

D. Those having most extreme dentofacial deformities requiring many years of orthodontic treatment.

E. Those having extreme dentofacial deformities but being so uncooperative as to justify no expenditure of funds for orthodontic treatment.

The dental standard maintained in the Navy Recruiting office[5] requires a man to be able to chew adequately before enlistment. A man is considered a poor health risk if he does not have a certain number of teeth in occlusion.

Dentists and orthodontists are well aware of the lasting benefits to be derived from a good occlusion. An orthodontist readily recognizes dentofacial deformities and their causes in their earliest stages. He can do much to prevent the serious deformities so common among the children applying for State Aid orthodontics. Both orthodontists and physicians should be on the determining board when children having dentofacial deformities are selected to receive certification for treatment for county, state or federal funds.

Those children who have received treatment, who were misfits socially, who would not go to school because of the frightful conditions of their mouths, have developed into splendid examples of young manhood and young womanhood. Patients who would not remain in the reception room with other patients because of their facial deformities and odor of their gums putrid from lack of occlusion and dental neglect, have changed to be leaders in school classrooms and on the athletic fields. The sincere gratitude of these rehabilitated

children makes this type of orthodontic work a little more enjoyable. It is regrettable that more children having such handicaps cannot receive orthodontic treatment.

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601 MEDICO-DENTAL BLDG.

ORTHODONTIC JUDGMENT

FRED RALPH BLUMENTHAL, D.M.D., BOSTON, MASS.

THE presentation of case reports to this group under the title "Orthodontic Judgment" needs perhaps a word of interpretation. The word *judgment* is one which we use freely but with little thought as to its real implication.

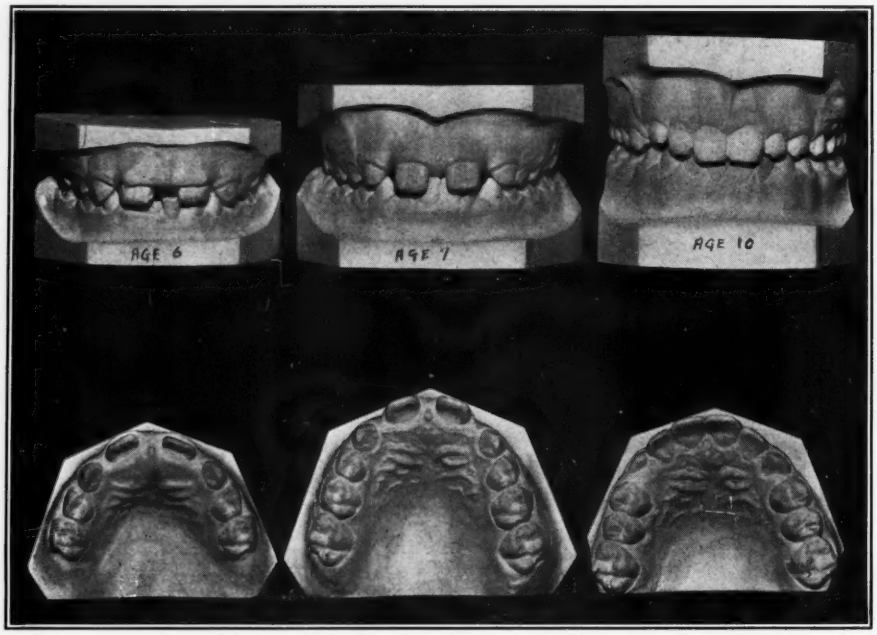

Fig. 1.—Enlarged frenum; not removed and no surgery.

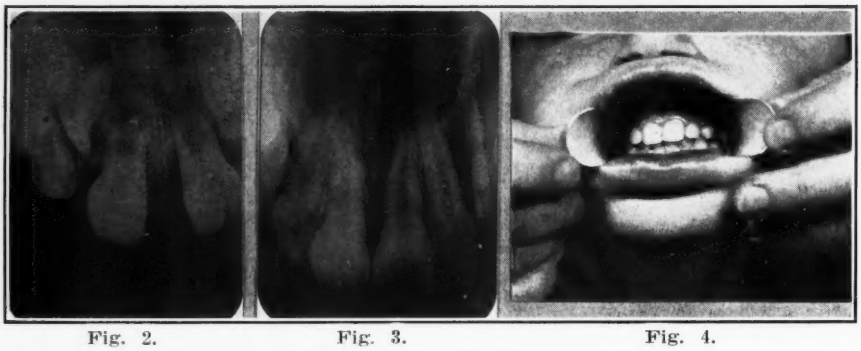

Fig. 2. Fig. 3. Fig. 4.

Fig. 2.—X-ray film at six years.
Fig. 3.—X-ray film at ten years.
Fig. 4.—Photograph of dentition at ten years.

Webster defines *judgment* as "that operation of the mind involving comparison and discrimination . . . by which knowledge of the values and relations of things is formulated."

Case reports presented at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, April 20, 1937.

As orthodontists I feel certain we can apply this to our own particular field with the resulting conclusion that the exercise of orthodontic judgment involves much more than recognition of crooked teeth and the making of an appliance to correct them. If true orthodontic judgment is to be exercised, each new case must be studied individually and the sum total of factors involved must be carefully weighed before determining whether or not orthodontic treatment should be undertaken.

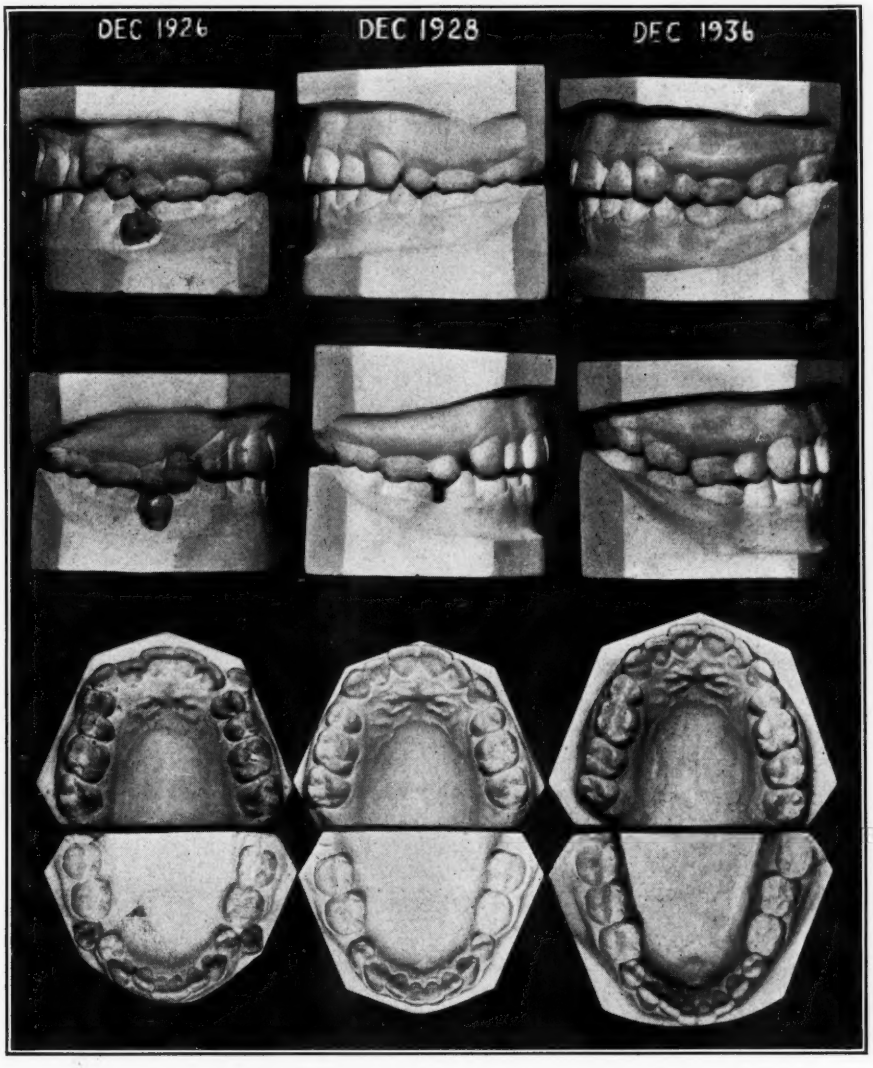

Fig. 5.—Extraction of four premolars. No orthodontic treatment.

Case 1.—Enlarged frenum at age of six years. The frenum was not removed and at the age of ten years had completely resorbed. X-ray pictures at the ages of six and ten years show the resorption of bone between the two central incisors. (Figs. 1-4.)

Case 2.—Extraction of four premolars—two maxillary and two mandibular. Circumstances involved made orthodontic treatment absolutely impossible. In

Fig. 6.

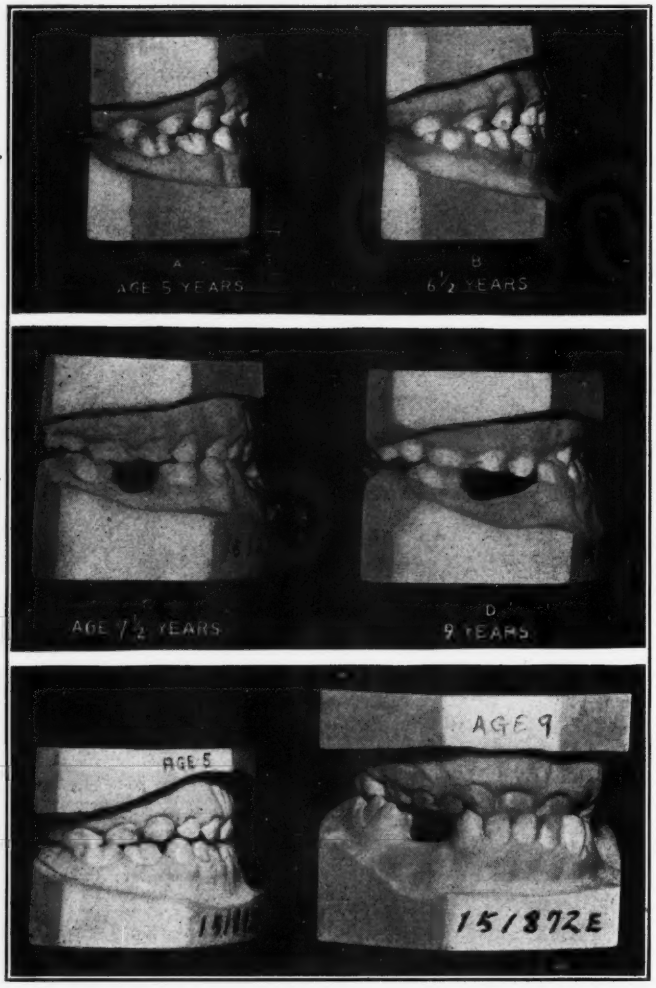

Fig. 7.

Fig. 8.

Figs. 6-8.—Cross-bite due to tongue habit; progressive deformity.

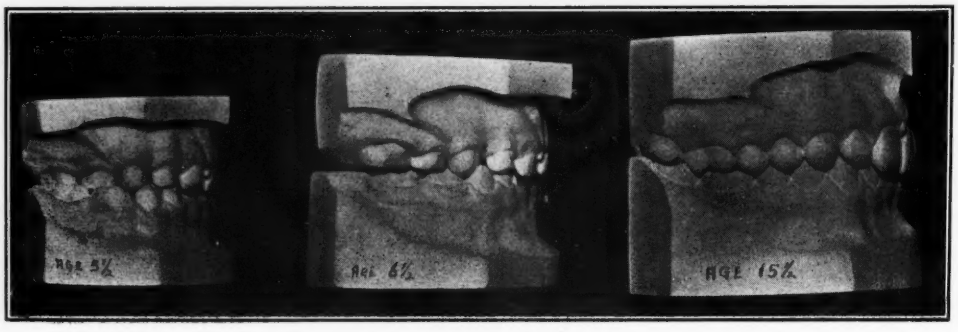

Fig. 9.—Cross-bite.

this case, no appliances had ever been inserted in the mouth. The only treatment rendered was the extraction of the right maxillary first premolar, right mandibular second premolar, left maxillary first premolar, and left mandibular second premolar, as illustrated. (Fig. 5.) (Courtesy of Edward I. Silver, D.M.D., Boston, Mass.)

CASE 3.—Cross-bite, due to tongue habit. No orthodontic treatment; progressive deformity. Illustrations (Figs. 6-8) are self-explanatory. (Courtesy of Forsyth Dental Infirmary for Children, Boston, Mass.)

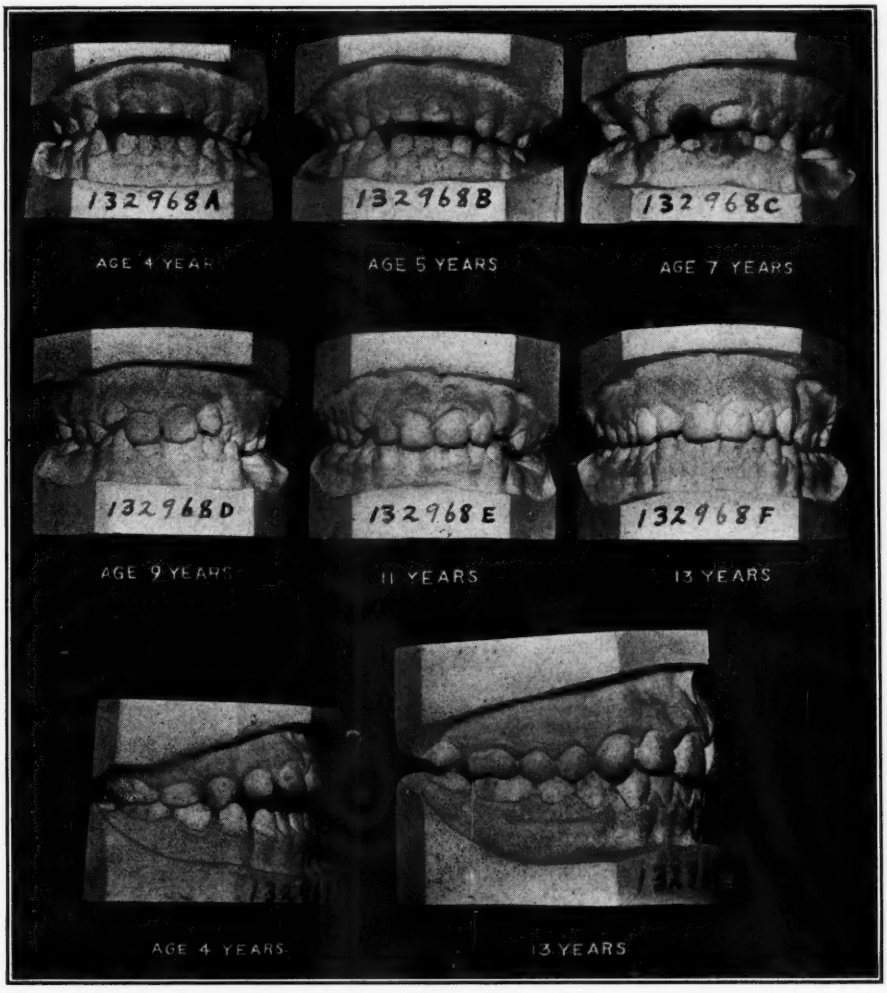

Fig. 10.—Thumb-sucking habit, no orthodontic treatment.

CASE 4.—Cross-bite treated at the age of five and a half years, for approximately six months. No appliances used after the age of six and a half years. No further treatment was necessary in the permanent dentition. (Fig. 9.)

CASE 5.—Thumb-sucking habit broken at the age of four years; no orthodontic treatment. Fig. 10 shows condition from the age of four years to thirteen years. Self-explanatory. (Courtesy of Forsyth Dental Infirmary for Children, Boston, Mass.)

CONCLUSION

I have tried to select for presentation cases which I hope have been illustrative of what I meant when I said real judgment is necessary for successful results in orthodontics. In other words, let us realize that generalities are dangerous; each case is a law unto itself. Good orthodontic judgment demands careful consideration of all the factors involved in the growth and development of the human organism with which we are concerned.

EXTRACTION OF ALL FOUR PERMANENT SECOND MOLARS TO MAKE ROOM FOR THIRD MOLARS

Louis S. Winston, A.B., D.D.S., Houston, Texas

HISTORY.—Orthodontic treatment of this little girl (Fig. 1) was begun June 15, 1925, at age eight and three-fourths years. She is an only child. The adenoids and tonsils had been removed at age three or four years. She

Fig. 1.

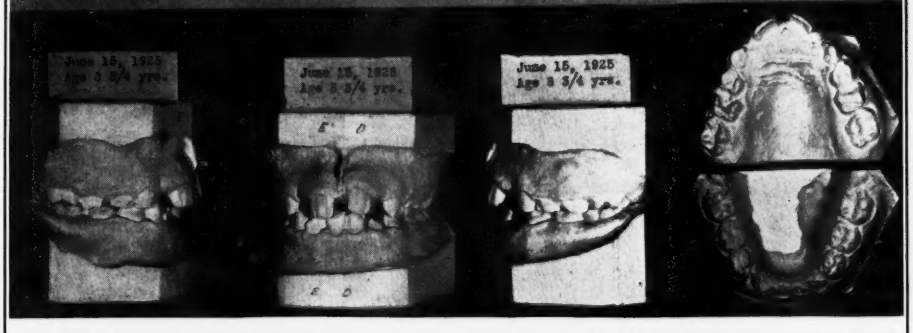

Fig. 2.

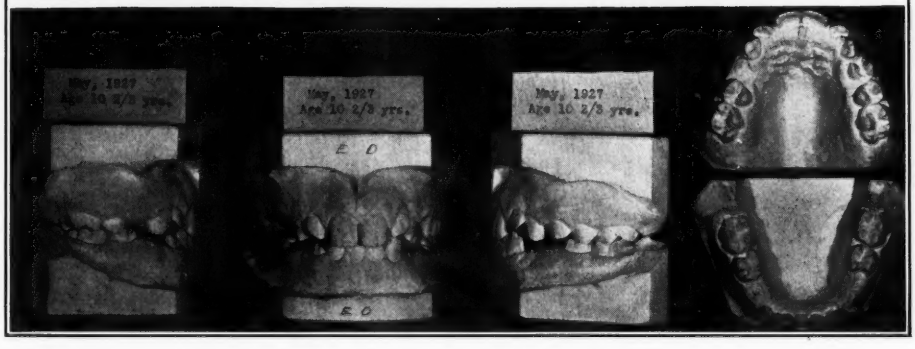

Fig. 3.

had frequent colds and attacks of sinus infection from about the age of three until several years after the orthodontic treatment was begun. As a young baby she had a habit of sucking two fingers. She was breast-fed the first six

Case report presented at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, April, 1937.

or seven months and then put on Mellins Food. She was most likely a mouth-breather for a part of the time, during the frequent colds and particularly at night. She had had the following childhood diseases: measles, whooping cough, chickenpox and ring-worm of the scalp. (Fig. 2.)

Neither parent had any very marked malocclusion, but the mother is a very slender type of individual, with narrow dental arches. X-ray pictures were made in the beginning. I did not then have a machine, and sent out my work to a very fine physician whose technician was a graduate nurse. Because the films were not properly washed after fixation, they have faded out, and damaged other films with which they were in contact.

Attributed Etiology.—The arches are probably naturally narrow through heredity. Their growth has probably been further retarded by systemic weakness, including some disturbance of calcium metabolism, and the almost constant infection of the nose and sinuses. The case is complicated by the presence of an abnormal frenum labium, and by the premature loss of the mandibular left canine.

Diagnosis.—Neutroclusion, complicated by abnormal frenum labium and premature loss of mandibular left canine.

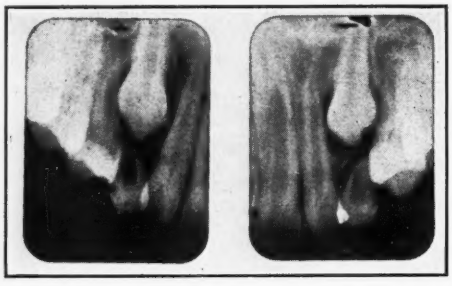

Fig. 4.

Treatment Therapy Employed.—Lingual appliances were placed on both arches with auxiliary springs for expansion and for moving the mandibular incisors labially and to the right. The maxillary central incisors were banded for rotation, and a labial placed on the maxillary arch with loop springs for bringing the central incisors together. After a few months it was decided to add a labial to the mandibular in order to control the incisors better. Treatment was carried on in this manner until May, 1927, when all appliances were removed, which, with two summer vacations totaling five months deducted, leaves eighteen months of active treatment. The case then presented the condition shown in Fig. 3. By this time I had purchased my own x-ray equipment, but unfortunately these films were filed with the others and were spoiled. I wish to stress that the frenum was not surgically removed. I have never removed one or had one removed.

The case was seen monthly for inspection. Fig. 4 shows x-ray pictures taken October 26, 1927, and January, 1928, when the mandibular labial arch was replaced because the mandibular incisors were drifting back toward their old positions. On March 30, 1928, the maxillary labial arch was replaced, and on April 16 the patient was started wearing intermaxillary rubbers on the left side, which was continued for a few months.

In the fall of 1928 with patient aged twelve years, after interruption for another two months' vacation, the rotation of the maxillary lateral incisors by means of bands and grass line ligatures was commenced. It was also found necessary to rotate the mandibular left lateral incisor. On March 6, 1929, all appliances were again removed.

In October, 1929, patient aged thirteen years, lingual appliances were placed on both arches with finger springs for expansion. The mandibular appliance was removed the following April. The maxillary lingual appliance was worn until September, 1930, when the maxillary left canine was sufficiently erupted to be banded with a hook on the lingual of the band for rotation and on the labial to engage a finger spring attached to the labial appliance for the purpose of hastening eruption. Patient was then fourteen years of age. In December, 1930, the mandibular labial appliance was again put on, and both labial appliances were worn until June, 1931.

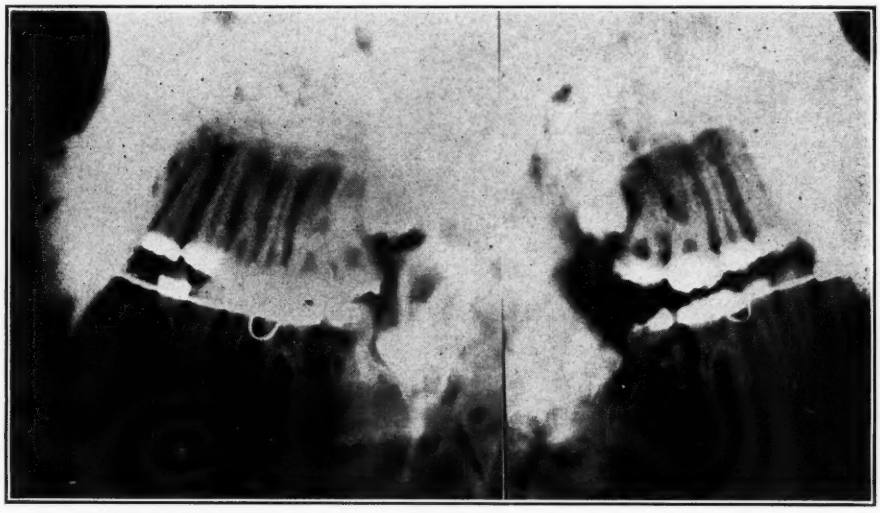

Fig. 5.

In September, 1931, both labial appliances were again put on, and rotation of the maxillary lateral incisors and left canine, and straightening of the mandibular anterior teeth again undertaken. By March, 1932, with the patient now fifteen and one-half years old, the right canine had just erupted sufficiently to be banded. The x-ray pictures in Figs. 5 and 6 were made June 25, 1932. It will be noted that the patient, during all this time, suffered a great deal of caries, practically all the posterior teeth having been filled, including the second molars. Attention is directed to what appears to be a small amount of root resorption on the maxillary lateral incisors. I banded both mandibular lateral incisors for rotation in July, 1932.

All four second molars were extracted August, 1932.

These pictures in Fig. 7, taken in December, 1932, were made for the purpose of checking the lateral incisors for further root resorption.

In January, 1933, it again became necessary to place intermaxillary rubbers on the left side. By this time the patient, aged sixteen years, was somewhat impatient for the removal of the appliances.

Fig. 6.

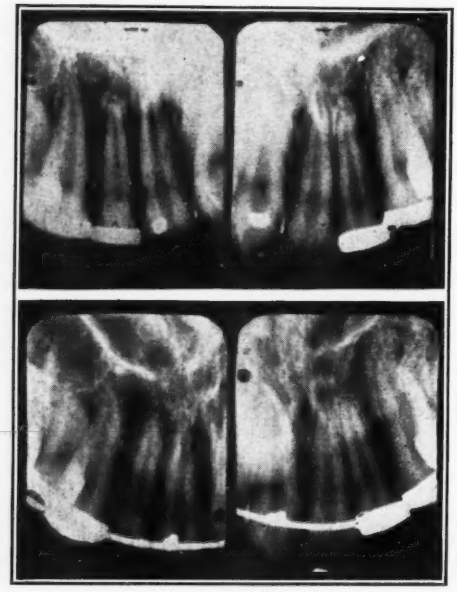

Fig. 7.

Fig. 8.

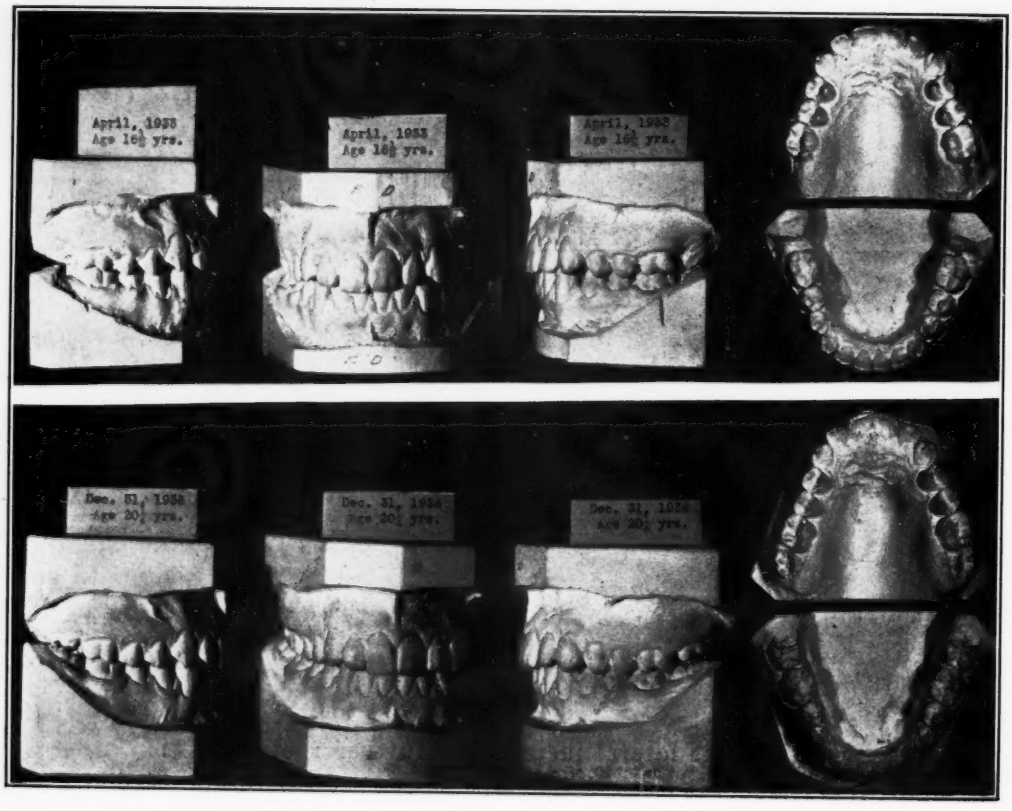

Fig. 9.

Active treatment was concluded in April, 1933, and Hawley retainers for both arches were given the patient (Fig. 8). Patient was instructed to do exercise of pressing with tongue on gum below mandibular incisors at least 200 times daily. By her later admission, she cast aside the retainers and discontinued the exercises after a few months.

A total of 69 months of active treatment had been given during an elapsed period of approximately eight years.

Fig. 10.

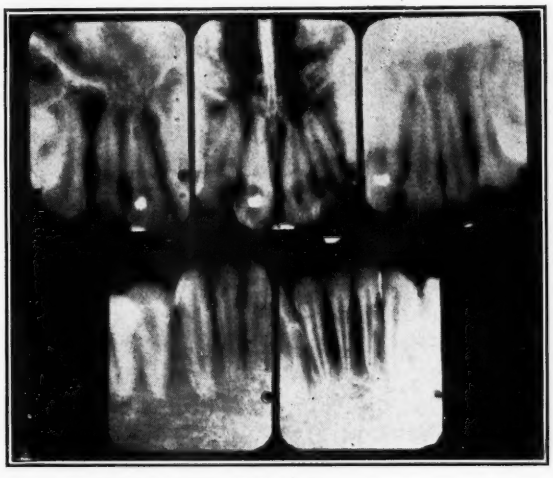

Fig. 11.

The patient did not report for inspection from August, 1933, until she was summoned to the office on December 31, 1936, for the making of the final models, photographs and x-rays shown in Figs. 9-11. It was noted that a small amount of root resorption on the apices of the maxillary lateral incisors, apparent in the earlier x-ray pictures, and for which nothing was done, appeared to have healed. Inquiry as to whether she had had a thorough physical examination in recent years elicited the information that one had been made in November, 1935. I consulted her physician, who stated that at that time

she had shown a basal metabolism of –23; a moderate secondary anemia (78 per cent); dietary disturbance (she was living largely on "cokes" and sweets), and acne, of which, of course, the cause is unknown. He had prescribed thyroid extract tablets, which she is still supposed to be taking. It is obvious that what little resorption did occur had ceased before the thyroid treatment was begun (Fig. 12).

Results Achieved.—Fairly satisfactory results have been obtained. As a matter of fact, the patient and her parents are delighted and are very grateful. A severe crowding has been eliminated by the extraction of the second molars. The positions of the third molars are now better than those of the second molars were before their extraction; they have all had to have occlusal fillings, but so had the second molars. The rotations of the maxillary canines were never completed because of their late eruption (14 and 15½ years) and because, before a tooth can be rotated, there must be space in which to rotate it. All the rotations of the maxillary anterior teeth have relapsed somewhat. There is now also some crowding of the mandibular anterior teeth.

Fig. 12.

Prognosis.—It is believed that the occlusion will remain as good as it is, and may be improved by a little grinding of the canines.

Observations and Conclusions.—It is my opinion, based on this and other cases, that in certain selected instances it is better to remove second molars than third molars. To make such a decision it is necessary to study each second and third molar individually, taking into consideration all other features of the case. Furthermore it is my opinion that the orthodontist's responsibility includes the problem presented by the third molars, and that he cannot properly discharge a case until he has dealt with that problem.

It is worthy of note that here is presented a case having had prolonged orthodontic treatment, of quite low basal metabolic rate, with some dietetic disturbance, which showed only a small amount of root resorption. Labial appliances, with bands on the affected teeth for their rotation, were worn for ten months after the date resorption is shown to have ceased. About three and one-half years after the resorption ceased, the patient was shown to be suffering from hypothyroidism, malnutrition and secondary anemia, without the occurrence of further root resorption.

STATIONARY ANCHORAGE

RICHARD LOWY, D.D.S., NEWARK, N. J.

SINCE I was limited to a ten-minute discussion of the edgewise arch mechanism, it was most difficult to decide what part of the appliance could be adequately discussed in the time allotted me.

After deciding upon my subject I realized that it would appear elementary to some of the men present. However, in reviewing the literature I found that the subject had not been discussed before this Society. Therefore I borrowed freely from several of the outstanding Angle adherents and shall attempt to present anchorage as applied to the new Angle appliance.

Allen C. Brodie made the following comment in the January, 1931, *Angle Orthodontist:* "This brings us to a consideration of what has always been the orthodontist's nightmare—anchorage, for it is in anchorage that the factor of safety lies to the greatest extent. Anchorage has probably been the greatest obstacle in the path of orthodontic progress. It has held us down to the point where we have dared to think of little else, and it has dictated all theories of treatment. We have had to unravel our cases tooth by tooth watching our anchorage with bated breath for fear that it would give way and bring our house of cards down around our ears. Some of the most necessary tooth movements in a great many cases were, and are being, winked at or completely overlooked owing to this fear."

To Newton we are indebted for the law: To every action there is an equal and contrary reaction. We make use of this law of force in the mechanical movement of malposed teeth, especially in the movement of teeth from points of dental resistance. Here we see that force extended to move one or more teeth has an equal force exerted in the opposite direction upon whatever is used for the base action. Since action and reaction are equal, the amount of movement is proportional to the respective resistances.

McCoy in the 1922 edition of his textbook *Applied Orthodontics* states: "In discussing the subject of 'Anchorage' different writers have submitted classifications which show a divergence of opinion." Therefore, since we are to discuss anchorage relating to the edgewise appliance, I quote the following definition from Dr. Robert H. W. Strang's *Textbook of Orthodontia:* "By Anchorage in Orthodontia, we refer to those units in the dental arch that, by virtue of their inherent stability, combined with their peculiar and favorable relationship to the mechanism by which teeth are moved, are capable of being used as the base from which the power, inherent in the appliance, can take its origin."

Read before the New York Society of Orthodontists, New York, N. Y., Nov. 24, 1936.

Dr. Cecil C. Steiner, in a paper presented in 1933 before the Edward H. Angle Society, said: "Let us remember that an orthodontic problem is like a game of chess. In chess a certain number of men on one side are pitted against a like number on the other. The problem being to outwit your opponent before he outwits you. In orthodontia a given amount of resistant tissue, the opponent, is available against which to pit a certain amount of tooth movement, one's own 'men,' the problem being to transform or translate the resistance into the desired tooth movement with greatest efficiency and the least amount of waste, or before resistance gives way. Simple anchorage makes use merely of resistance of the superficial structure, while stationary anchorage uses it to the root ends, thus employing a solid wall of bone."

Logically it would appear that the most desirable type of appliance would be one in which stationary anchorage could be used and force controlled in the greatest possible direction or combinations of directions.

With the use of the tie bracket mechanism the arch wire is the factor of force while the brackets and bands are the fixation points between the teeth and energizing factor. This accounts for the fact that the slots of the bracket are so constructed as to hold exactly the arch wire. By this means the fixation is sufficiently rigid, and control of the exerted stationary anchorage and bodily movements of the teeth can be accomplished.

Thus by banding all the teeth and securing bracket engagement of the arch wire the teeth can be moved into their correct position. Furthermore each tooth is contributing its share of anchorage and the strain is no longer on the molar tooth.

Let us now discuss chiefly the use of additional force, the elastic band. The promiscuous use of intermaxillary elastics has done considerable harm when there has been a lack of operator's knowledge and proper understanding of the use and application of stationary anchorage.

Dr. Strang defines stationary anchorage as characterized by mechanical adjustment of fixtures upon the tooth or teeth chosen as anchor units as to necessitate such teeth being displaced bodily if they fail to withstand the force brought to bear upon them.

It must be borne in mind that in extreme cases of maxillary protrusion the axial inclination of the incisor teeth must be corrected first. Why? Because they afford stationary anchorage and with the use of elastics will undoubtedly permit an undesirable tipping of the mandibular incisors. Therefore the first step to be taken is that of breaking up maxillary stationary anchorage by changing the axial inclination of the incisors, and the closing up of the spaces in the maxillary arch. A round 0.018 or 0.020 stainless steel arch wire should be used at first. By shortening the wire with loops the spaces are closed, and crowns of the protruding incisors may be tipped back without appreciable movement at the apex, and without much displacement of the molar teeth.

The use of a light wire in the mandibular arch in order to obtain the necessary bracket engagement, the gradual stepping up of the wire from 0.018 to 0.020, 0.022 × 0.028 will materially assist in changing the exaggerated curve

of Spee. The elevation of the molars and premolars and the depression of the incisors are of utmost importance. Slight distal bends in the mandibular 0.022 × 0.028 arch wire can be used to insure against undesirable displacement of the incisors. The combination of the maxillary tip back bends and the intermaxillary elastics will cause the proper distal movement of the maxillary teeth to eliminate the so-called toothy appearance obtained when improper treatment is instituted.

The progress of successful movement of teeth depends largely upon the operator's appreciation of the dynamics involved in whatsoever appliance he may use. I fully realize that I have merely scratched the surface in discussing anchorage, and I hope that this paper will merely act as a stimulant for additional thought along these lines.

CASE OF UNILATERAL DISTOCLUSION TREATED WITH A MINIMUM OF APPLIANCE

WILLIAM J. SPEERS, D.M.D., BOSTON, MASS.

THIS clinic is presented to demonstrate an efficient method of treating a case of unilateral distoclusion, using a minimum of appliance.

Fig. 1.—Casts before treatment.

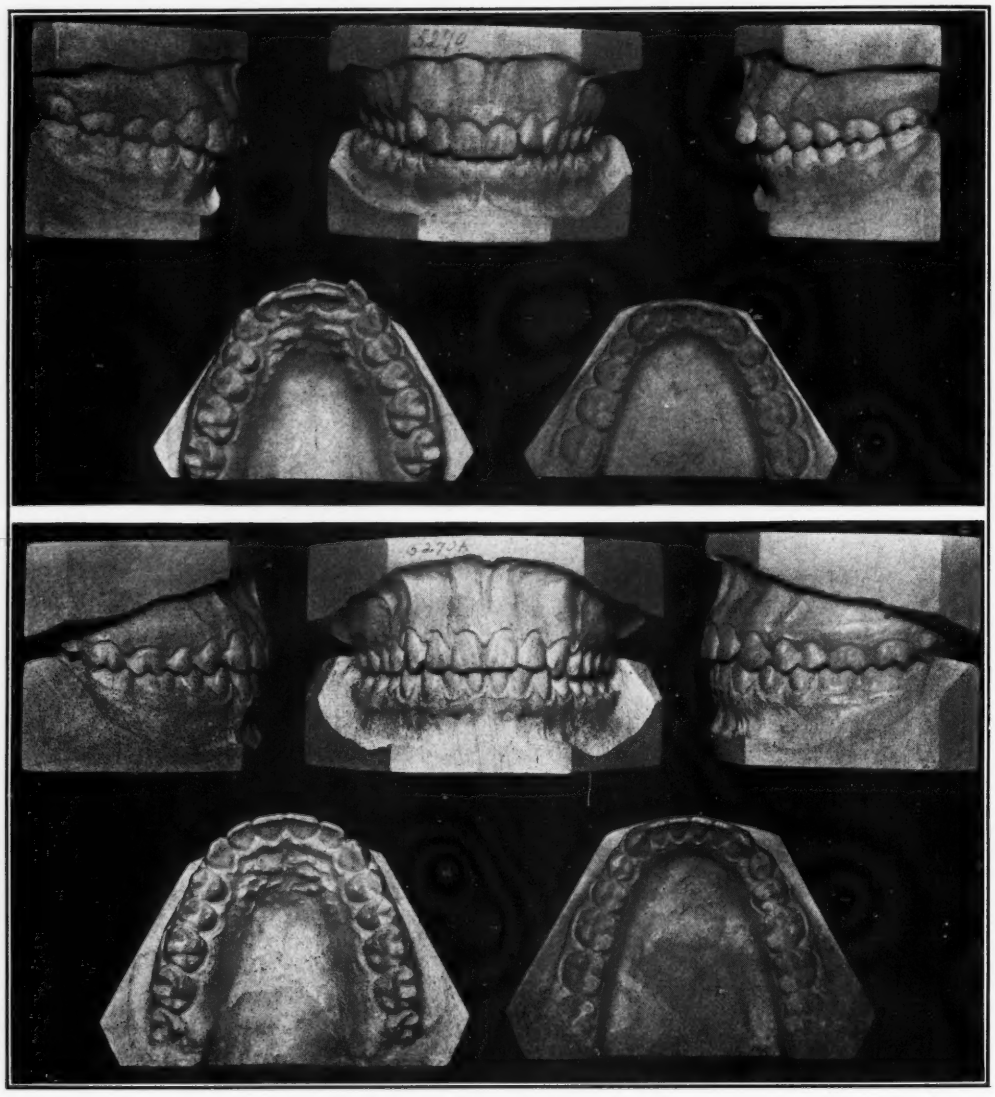

Fig. 2.—Casts after treatment.

In the majority of cases of this type of malocclusion there exists a lack of general development of one or both arches in addition to the mesiodistal

Clinic given before the American Society of Orthodontists, Chicago, April 20, 1937.

malrelationship of the molars and premolars on one side. It will frequently be found that there exists, to a marked degree, a lack of lateral development in the canine and premolar area in the maxillary arch on the side opposite to the one possessing the mesiodistal malrelationship of the molars and premolars.

Treatment of the case shown consisted in placing bands, with half round tubes on the lingual surface, on the maxillary and mandibular first molars to which were attached removable lingual wires. With these general development was obtained. At the same time the molars on the maxillary left side were carried distally by opening the loop on this side about one-half millimeter every three weeks.

Fig. 3.—Appliance used in treatment of this case.

After eleven months of treatment a sectional appliance was added, which consisted of a bracket band on the maxillary left canine from which the removable sectional was carried to a half round tube on the buccal surface of the molar band. The bracket band should be reversed from the usual procedure, having the opening of the bracket toward the gingiva. This is done to prevent too much strain on the lock pin. A hook to engage the intermaxillary elastic was placed on the sectional appliance just distal to the canine. Elastics were worn for six months, after which retaining appliances were substituted for the active appliances.

Department of Oral Surgery

Edited by

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HISTOPATHOLOGIC STUDIES IN CONGENITAL SYPHILIS

LESTER W. BURKET,* D.D.S., M.D., NEW HAVEN, CONN.

INTRODUCTION

CERTAIN dental anomalies are frequently present in congenital syphilitics. This paper will review briefly the various explanations for the genesis of these dental defects and will record in detail the dental histopathologic studies made on two congenital syphilitic infants.

LITERATURE

The possible relation between syphilis and certain dental anomalies was mentioned by Sanchez,[1] but it remained for Jonathan Hutchinson[2, 3, 4] to describe and to study them in detail. Subsequent investigations have dealt for the most part with the diagnostic significance and relative frequency of these dental changes. These clinical studies have been reviewed recently by Johnston,[5] whose paper includes an extensive bibliography.

The genesis of the Hutchinsonian tooth has aroused much speculation. Cedercrentz[6] has collected evidence which he feels speaks for a possible endocrine genesis, not only for the teeth but also for the parenchymatous keratitis and the typical labyrinthine defect. The syphilitic infection may act through the endocrine system in producing the enamel hypoplasias, microdontism, delayed eruption, and spacing of the teeth. He even suggests organotherapy as a possible means of warding off some of these stigmas. Clark's[7] report of a rare dental anomaly occurring in a congenital luetic individual was also ascribed to endocrine dysfunction. The lack of specificity of the commonly associated dental defects has been stressed by Roy,[8] who states that any disease acting on the infant (fetus) as early as syphilis, or during the first three months after birth, would produce typical Hutchinsonian teeth. He cites cases of bronchopneumonia at an extremely early age, which caused these dental anomalies. In utero changes occurring in chronic alcoholics or certain of the toxemias of pregnancy might affect the histogenesis of the tooth to produce the commonly seen dental defects. In other words, Hutchinsonian teeth are not specific for lues but for any condition of sufficient severity which attacks the infant at this

*Instructor in Dental Pathology, School of Medicine, Yale University.

age. Black[9] also believes that these dental defects are nonspecific and are based on nutritional causes. Poor[10] suggests that the dental hypoplasias are the expression of a generalized faulty development occurring in infected individuals. Stein,[11] on the other hand, questions whether any disease other than syphilis has produced the typical Hutchinsonian teeth, but believes that the spirochetes act indirectly in producing these hypoplasias by affecting the metabolism of the young organism.

In contrast to the numerous clinical investigations, comparatively few histopathologic studies have been made of these defects. The possible effect of congenital syphilis on the deciduous teeth has been mentioned, but the changes in the deciduous series of teeth have not been described in detail.

The bone changes in congenital syphilis were carefully studied by Lindsay and his coworkers.[12] Due to technical difficulties, the flat bones and the bones of the skull were not examined, but their findings in the long bones revealed that pathologic changes were confined to the periosteum alone. In infants a productive periostitis was observed which consisted of irregularity and thickening of this structure. McLean[13] made a correlative gross, x-ray and microscopic examination of the osseous tissues in congenital lues, but the dental tissues were not studied. Buschke and Lauger[14] stressed the importance of hypoplasia of the premaxilla and the symphysis mandibularis in congenital lues. They believed that the peculiar shape of the incisor teeth was due primarily to the hypoplastic development of their bony matrices. Smith[15] explained the form of the Hutchinsonian incisor on its development from two centers of ossification instead of the usual three. This explanation would not account for the cuspal pattern of the first permanent molars which is believed by many to be more frequently found, and diagnostically more significant than the incisal changes.

The deciduous series of teeth have been mentioned frequently in relation to congenital syphilis. Moody[16] cites case histories to support his belief that delayed eruption of the deciduous teeth in congenital syphilis is of diagnostic significance even when the other commonly described anomalies are absent. No histologic changes were reported in Cavallaro's[17] extensive study, but dystrophies (gross?) of the deciduous series were said to be present. Sanchez[1] also noted deciduous tooth dystrophies in congenital syphilis. Karnosh's[18] excellent work deals solely with the permanent dentition. He states that syphilis exerts a marked effect on the enamel organ activities as soon as the individual is separated from the placental circulation, and that the dentin of the teeth (permanent) is little affected.

Numerous attempts have been made to demonstrate the spirochete in the dental tissues. They have been demonstrated in the tooth germ, the non-calcified dentin, calcified dentin, in the dental sac, the enamel germ and the enamel epithelium by Bauer.[19] He found the spirochetes most numerous in the areas of most intense growth; namely, the basal portions of the tooth germ. He believed that the enamel hypoplasias were due to injury of the ameloblasts caused by edema and hemorrhage. At first Cavallaro was unable to demonstrate the spirochetes in the dental tissues; but by improved technique and the use of May Grünwald Giemsa stain, they were later demonstrated in the vessel walls.

Koehler[20] attempted to demonstrate the spirochete by a silver impregnation technique. Hill's[21] thorough investigation was made on nine suspected congenital luetic fetuses. The enamel organs of the first incisors and molars were handled identically with the sections from the liver of the same fetus and stained by Levaditi, Warthin-Stary, Jahnel and Giemsa techniques. Liver sections of six fetuses showed spirochetes similar to those of syphilis. In no case was there absolute evidence of a spirochete in the dental anlage.

MATERIAL

Histologic studies were made on the teeth and supporting structures of two congenital luetic infants four and eight and one-half months of age, both of whom had received antiluetic treatment. Diagnosis of congenital syphilis was established in both cases on the basis of the clinical history, serologic, roentgenologic and postmortem examinations. The mother of each of the infants had a four-plus Wassermann. These infants presented no known vitamin deficiencies clinically or on pathologic examination, but the older infant was markedly emaciated.

The maxillas and mandibles of both infants were studied. Gross descriptions were made of the specimens, after which roentgenograms of the infants' jaws were taken. The tissues were fixed in 10 per cent formalin, dehydrated, imbedded in celloidin, and decalcified in 10 per cent acetic acid. The maxillas and mandibles were divided in the midline, and one quadrant from each was sectioned from buccal to lingual in a vertical plane; the other in a horizontal plane. Serial sections were cut at approximately 12μ, and every tenth section was mounted for routine study and stained with Delafield's hematoxylin and aqueous eosin. The various steps in the preparation of the material for histologic examination have been reported previously.[22]

Mallory's connective tissue, thionin and Pianese III stains were used for a more intensive study of the structural changes observed in the routine hematoxylin and eosin stained material. Attempts were also made to demonstrate the *Treponema pallidum* in the dental tissues by Levaditi's stain and Giemsa aniline techniques, but no structures definitely resembling spirochetes were seen.

The roentgenologic and histologic findings were compared with similar studies on nonsyphilitic infants of comparable ages. These controls failed to show any of the histologic changes observed in the congenital luetic infants.

OBSERVATIONS

1. Gross and Roentgenologic Findings:

a. Four-month-old infant. No teeth were visible on direct examination of the mouth, but palpation of the incisor region revealed the presence of the developing deciduous teeth. The oral mucous membranes were not remarkable. Roentgenologic examination of the jaws revealed no unusual findings. The deciduous teeth were all visualized by roentgenogram in their usual position. Root formation had taken place in the deciduous incisors, and the crowns of both deciduous molars appeared calcified. The crypts of the mandibular first permanent molars were present, and early evidence of calcification of the mesial and distal cusps was noted, the mesial being more advanced than the distal.

b. Eight-and-one-half-month-old infant. The four first incisor teeth were found erupted. They presented no visible malformations or hypoplasias of the enamel. The mucous membranes of the mouth were not remarkable. Roentgenologic examination of the jaws revealed no unusual findings. The permanent incisor crypts were clearly visualized. The crowns and portions of the roots of the deciduous molars appeared completely calcified. The first permanent molar crypts were visible, and the mesial cusps of this tooth were definitely calcified, the distal cusps being less clearly defined. The degree of development of the permanent molars was only slightly more advanced than that observed in the preceding case.

2. Histopathologic Examination: Since the changes observed in the dental tissues and supporting structures of both infants were in most instances similar in type, and varied only in degree, they will be described together.

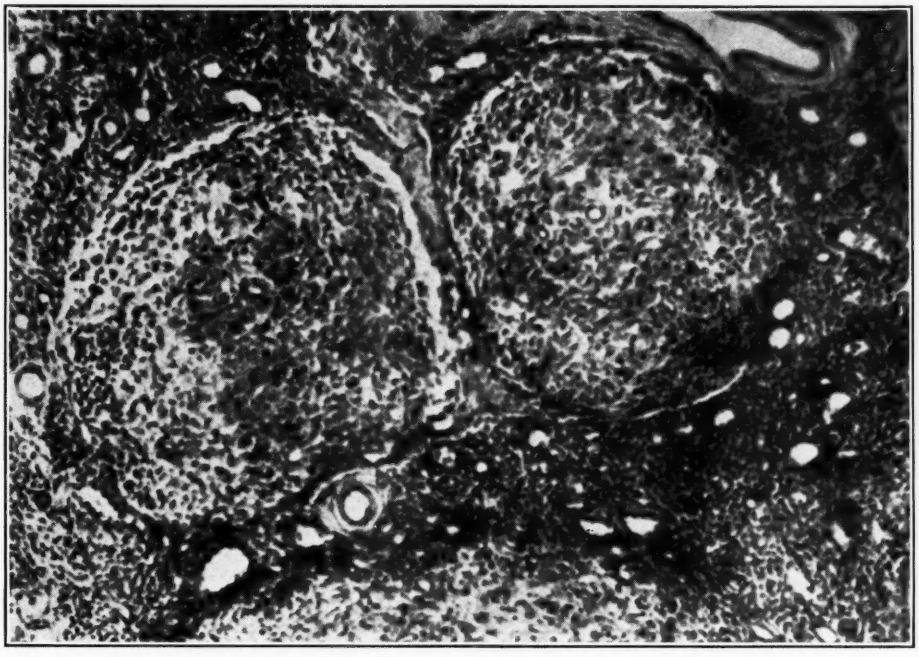

Fig. 1.—Lymph node with circumscribed areas of necrosis (×35).

a. *Gingival Tissues.* The mucous membrane covering the maxilla and the mandible was of uniform thickness and had a thin, regular, keratinized surface. At more or less regular intervals, invaginations of the epithelium were observed which terminated in the adjacent connective tissue, or were continuous either with small developing enamel organs or the external layer of the enamel organs of more fully developed teeth.

Beneath the angle of the mandible in the four-month-old infant was a structure which had the architecture and cellular elements of a lymph node. Throughout it were numerous circumscribed areas of necrosis and hypertrophy of the reticular cells. No giant cells were observed. Moderate amounts of connective tissue were observed throughout this structure, which was surrounded by a capsule of fibrous connective tissue. (Fig. 1.)

b. *Alveolar Bone.* The entire cortical bone had a mottled appearance which was due to numerous deep purple staining, irregular-shaped areas. The appearance and arrangement of these areas suggested previous bone resorption

Fig. 2.

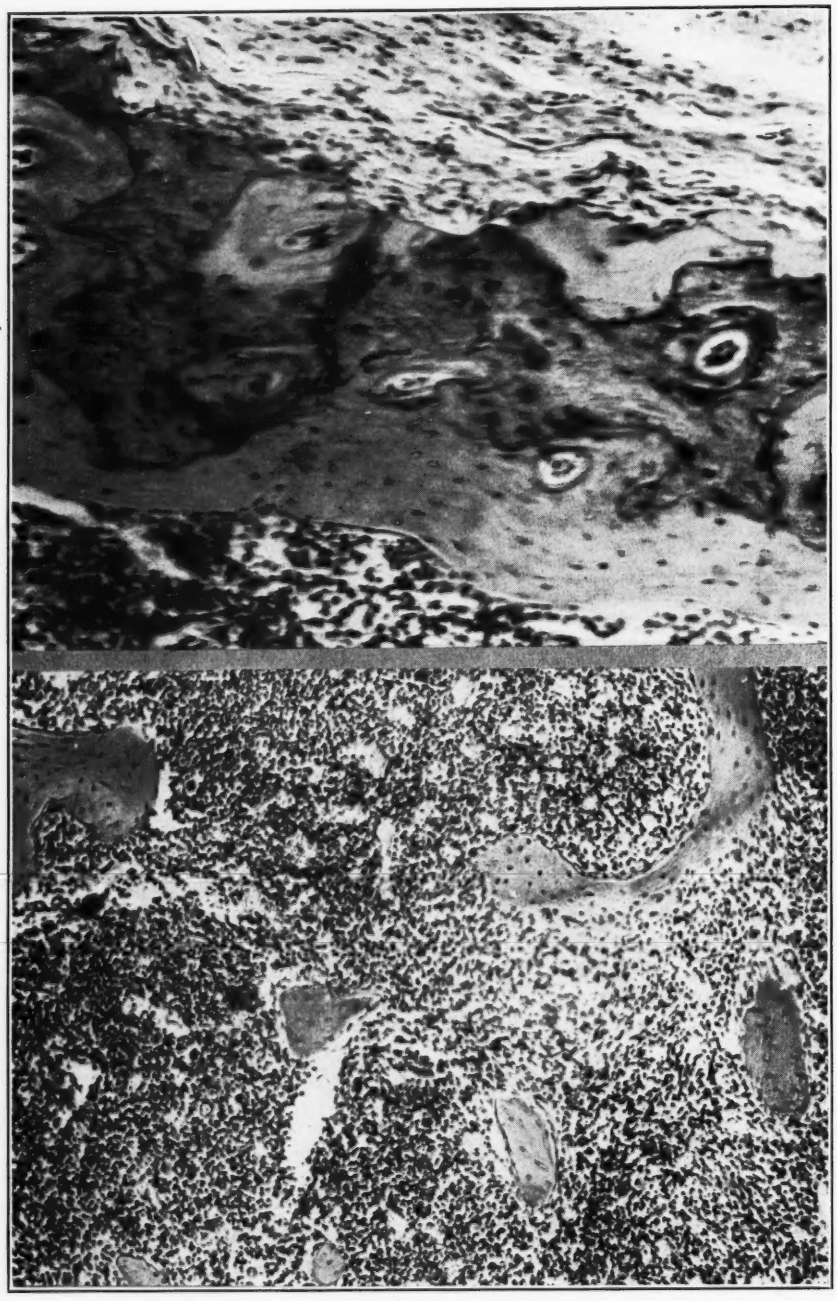

Fig. 3.

Fig. 2.—Mottled appearance of the alveolar bone (×35).
Fig. 3.—Alveolar marrow substance in mandible (×18).

with subsequent bone building. (Fig. 2.) Many small lacunae containing multinucleated giant cells were observed surrounding the dental follicles. These lacunae were most prominent about the developing deciduous teeth.

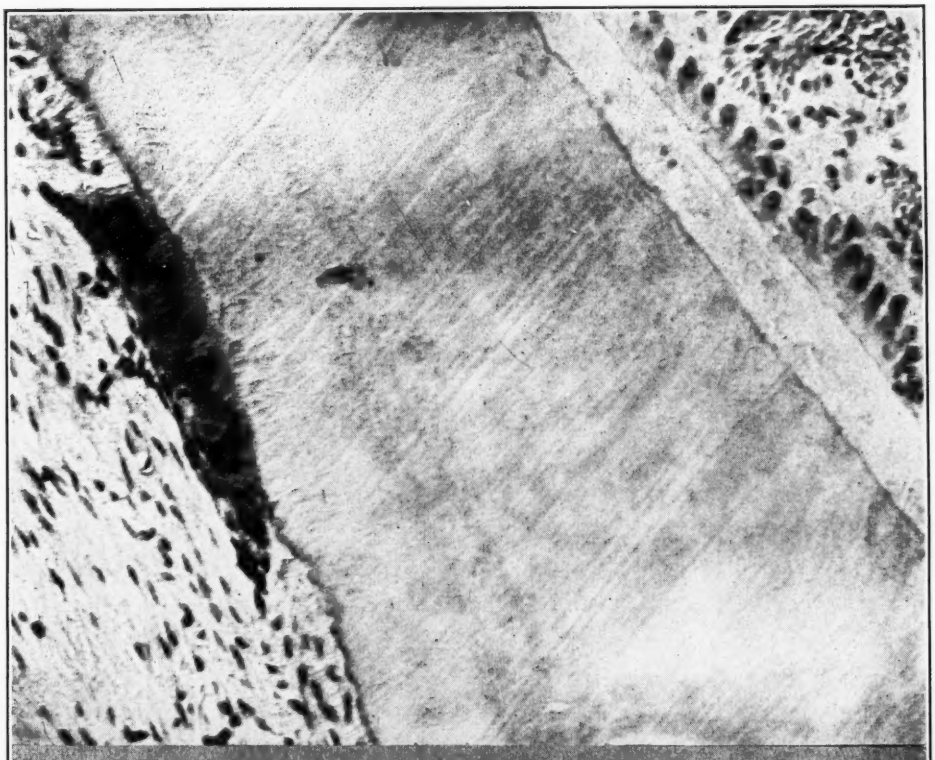

Fig. 4.

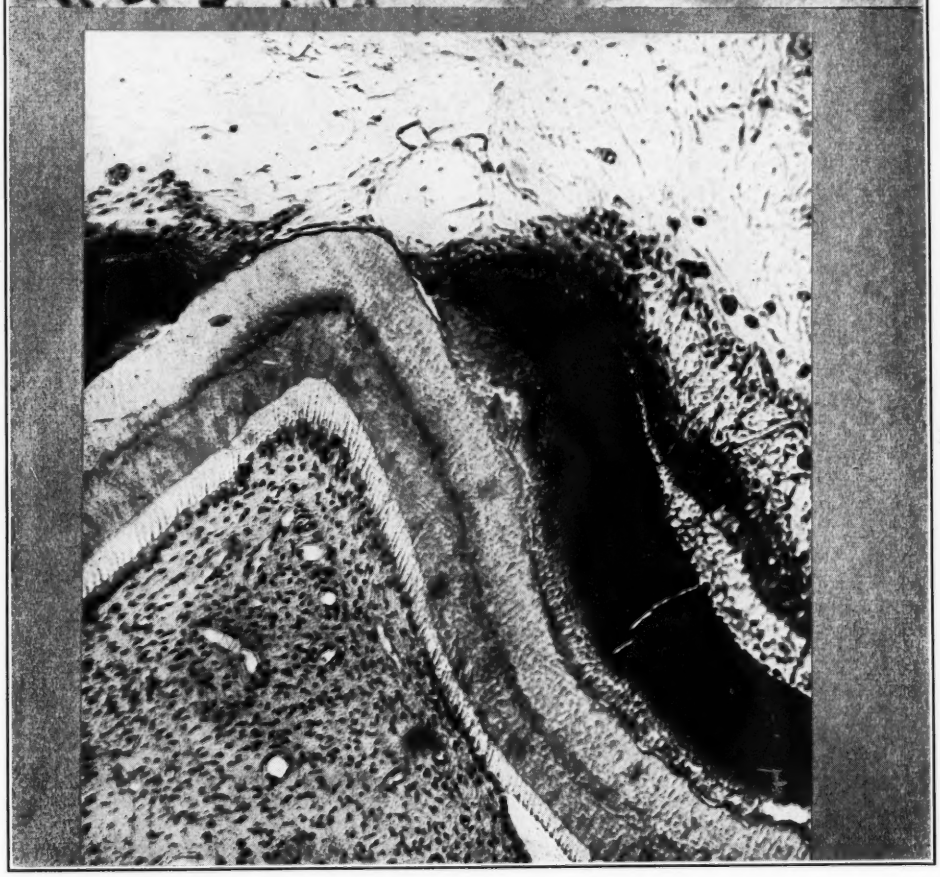

Fig. 5.

Fig 4.—Localized aplasia of ameloblastic tissue (×115).

Fig. 5.—Metaplasia of ameloblastic tissue and lack of enamel formation over cusps of first permanent molar (×115).

The marrow substance was relatively acellular in the maxillas. In the mandibles there was a slight increase in the number of cellular elements over that observed in nonsyphilitic infants of comparable age. The number of young cell forms was not increased, and the proportion of the different cell types was not remarkable considering the age of the infants. (Fig. 3.)

c. *Enamel Organ.* The changes observed in the enamel organs were confined to the developing first permanent molars. The remaining enamel organs of the permanent dentition were not present or differentiated.

Ameloblastic metaplasia was observed in the developing first permanent molars over the tips of the cusps and a short distance occlusal from the last formed enamel. This resulted in failure of enamel development over the cuspal portions of the dentin and the production of enamel buds with constrictions of the dentin near the neck of the tooth. In these areas the ameloblasts were replaced by a narrow layer of stratified squamous epithelium. (Figs. 4 and 5.) Irregular enamel deposition was observed over the occlusal surface of the developing tooth and also near the constriction of the crown caused by the enamel bud. (Figs. 6 and 7.)

Large and small cystic areas were present in the occlusal portion of the ameloblastic layer. In some instances they were single and confined to a small area; in others, they occupied over half the breadth of the crown. In most of these regions enamel had been laid down prior to this change; in others, no enamel was present. These cystic areas were filled with a coarse, pink-staining, granular material or numerous red blood cells. (Figs. 8 and 9.)

The ameloblasts bordering the cystic areas and the zones of enamel hypoplasia had lost their usual morphologic characteristics and appeared as light purple staining spherical cells with deeply staining, centrally placed nuclei. In many places the ameloblasts were separated from the stratum intermedium by red blood cells or an exudate of small round cells. (Fig. 10.) In places capillaries were observed in the immediate region of the ameloblasts. (Fig. 11.)

d. *Dentinal Tissues.* Lesions in the dentin, which were confined to the teeth of the deciduous series, were observed in the substance of the dentin and also along the pulpal wall. The former consisted of a marked change in the direction of the dentinal tubules in a zone slightly internal to the neonatal line. In this region the dentinal matrix also appeared poorly calcified (lighter staining), and structures resembling imbedded cells were occasionally seen. (Fig. 12.)

The odontoblastic layer was completely absent in many of the deciduous teeth, and was replaced by a deep blue staining line. (Fig. 13.) In other teeth, cystic degeneration of the odontoblastic layer had occurred in localized regions. Some of these areas contained no observable material; others contained large round cells of an undetermined type. (Fig. 14.) In the radicular portion of the more fully developed deciduous teeth, internal to the deep blue staining line previously described, a pink staining osteoid tissue had been deposited. (Fig. 15.) In some teeth this irregular dentin contained numerous small capillaries. Large irregular masses of pink staining osteoid tissue with tubular

structure were observed in the most apical portion of the pulp tissue. This osteodentin was not connected with the dentin of the tooth in the sections studied. (Fig. 16.)

Fig. 6.

Fig. 7.

Fig. 6.—Irregular enamel formation on occlusal surface (×18).
Fig. 7.—Enamel bud near amelocemental junction (×18).

The pulp tissue of the permanent teeth was not remarkable except for its embryonic appearance. The pulp tissue of the deciduous teeth, especially that

Fig. 8.

Fig. 9.

Fig. 8.—Large cystic change in ameloblastic tissue filled with pink staining granular material (×65).

Fig. 9.—Hemorrhage into cystic area in ameloblastic tissue. Edema of the ameloblasts (×115).

of the incisors, showed numerous changes. There was an increased vascularity throughout, many capillary loops occurred between the odontoblasts (Fig. 17),

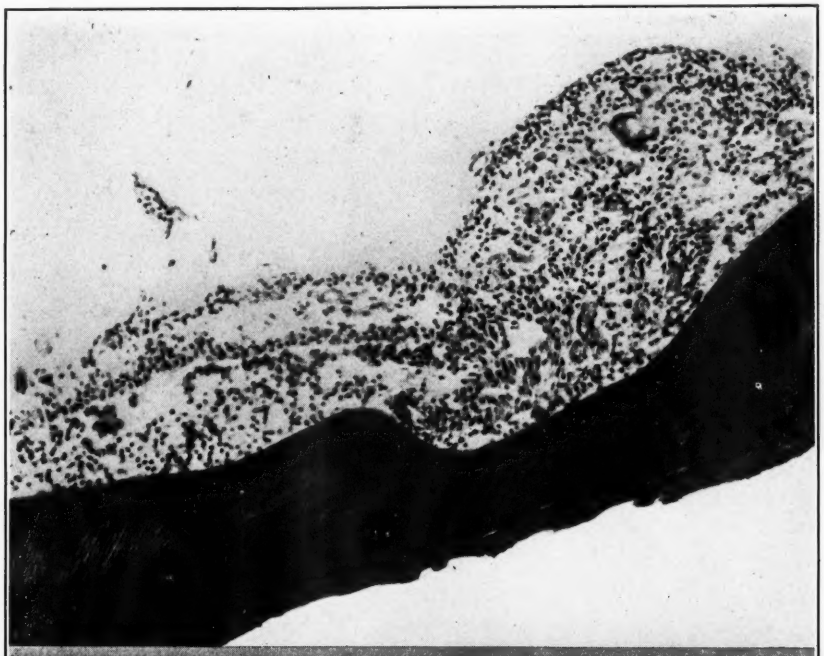

Fig. 10.

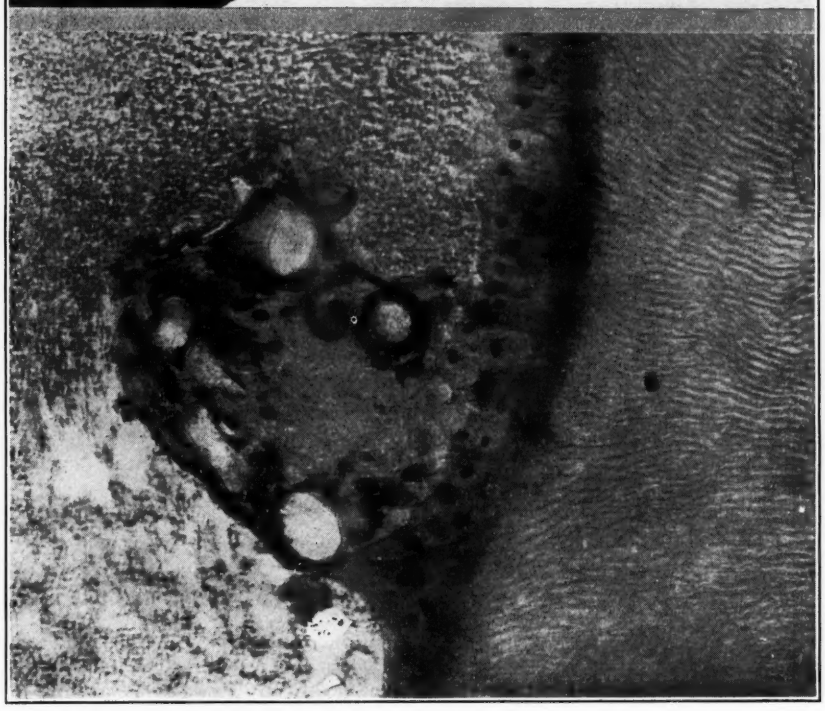

Fig. 11.

Fig. 10.—Exudate in ameloblastic layer (×65).
Fig. 11.—Capillaries adjacent to ameloblastic layer. Edema of the ameloblasts (×115).

and there was a perivascular small round cell infiltration. Numerous diffuse calcareous deposits were observed in the apical portion of this tissue. A well-

formed stone was present in the pulp of a deciduous molar of the four-month-old infant (Fig. 18). Groups of cells resembling undifferentiated endothelial cells were present in the pulps of the deciduous incisors. (Fig. 19.)

Fig. 12.

Fig. 13.

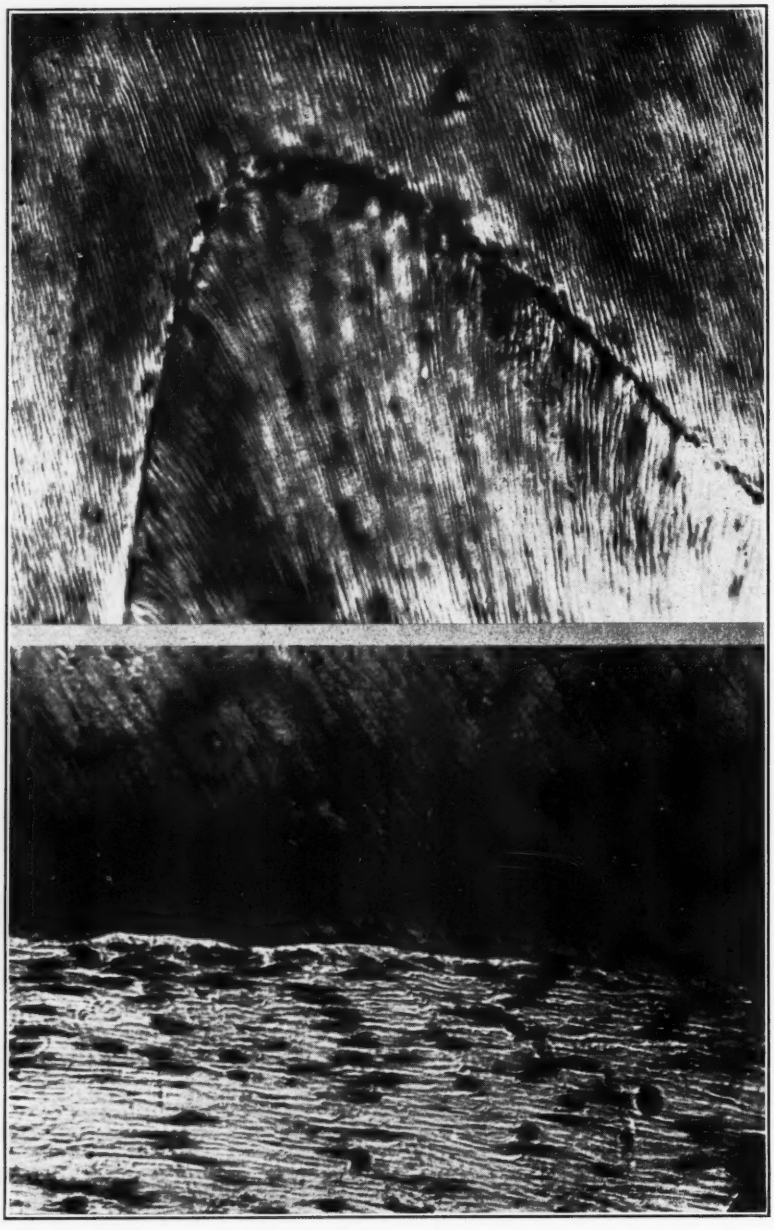

Fig. 12.—Dentin changes—deciduous teeth (×65).
Fig. 13.—Aplasia of odontoblastic layer (×115).

3. *Summary of Dental Changes:*

a. *Permanent Teeth.* The changes were confined to the enamel organ and consisted of localized areas of metaplasia and aplasia of the ameloblasts with failure of enamel formation, lack of enamel over the cuspal portions of the dentin, and cystic change over the occlusal surface of the enamel organ. Numerous

areas of irregular enamel formation were also observed. Dentinal changes were minimal and no abnormalities were observed in the pulp.

b. *Deciduous Teeth.* The changes were observed in the dentin and pulp, the enamel being of usual appearance and arrangement. The dentin of the

Fig. 14.

Fig. 15.

Fig. 14.—Cystic change in odontoblastic layer (×115).
Fig. 15.—Osteoid tissue adjacent to dentin (×65).

deciduous series showed a definite alteration in the direction and course of the dentinal tubules in the middle portion of this tissue just internal to the neonatal line. In many instances the entire odontoblastic layer was lacking; the internal boundary being represented by a deep blue staining line or a layer

of varying thickness of pink staining osteoid tissue. Small cystic changes were observed in the intact portions of the odontoblastic layer. Perivascular round

Fig. 16.

Fig. 17.

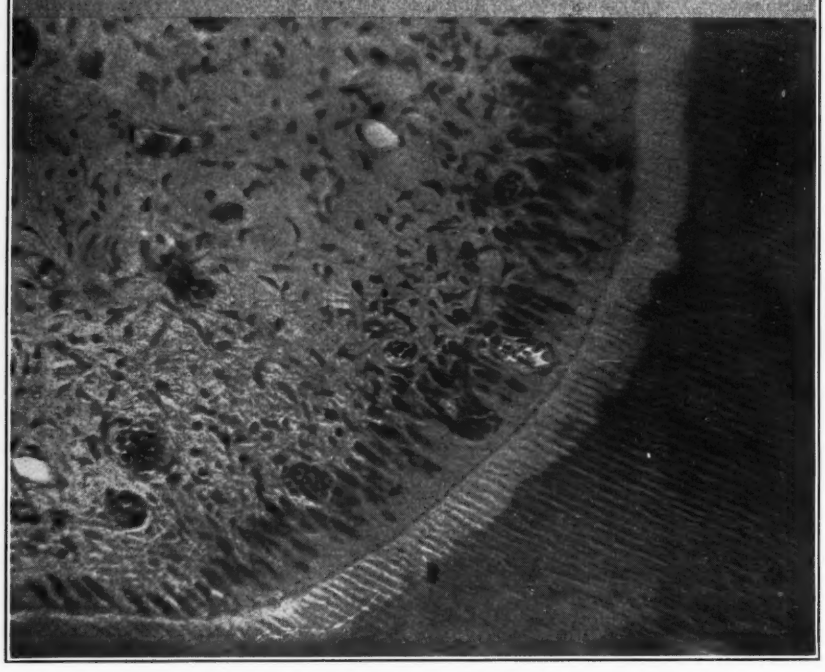

Fig. 16.—Irregular dentin formation in tissue of dentinal papilla (×18).
Fig. 17.—Capillaries in the odontoblastic layer (×65).

cell infiltrations were observed in the pulps, especially those of the incisor teeth. Masses of cells resembling undifferentiated endothelial cells and also diffuse calcareous deposits were observed in the incisor teeth. In the radicular portion

of the more fully developed teeth, internal to the deep blue staining line previously described, a pink staining osteoid tissue had been deposited which in some areas contained numerous small capillaries. Large irregular masses of

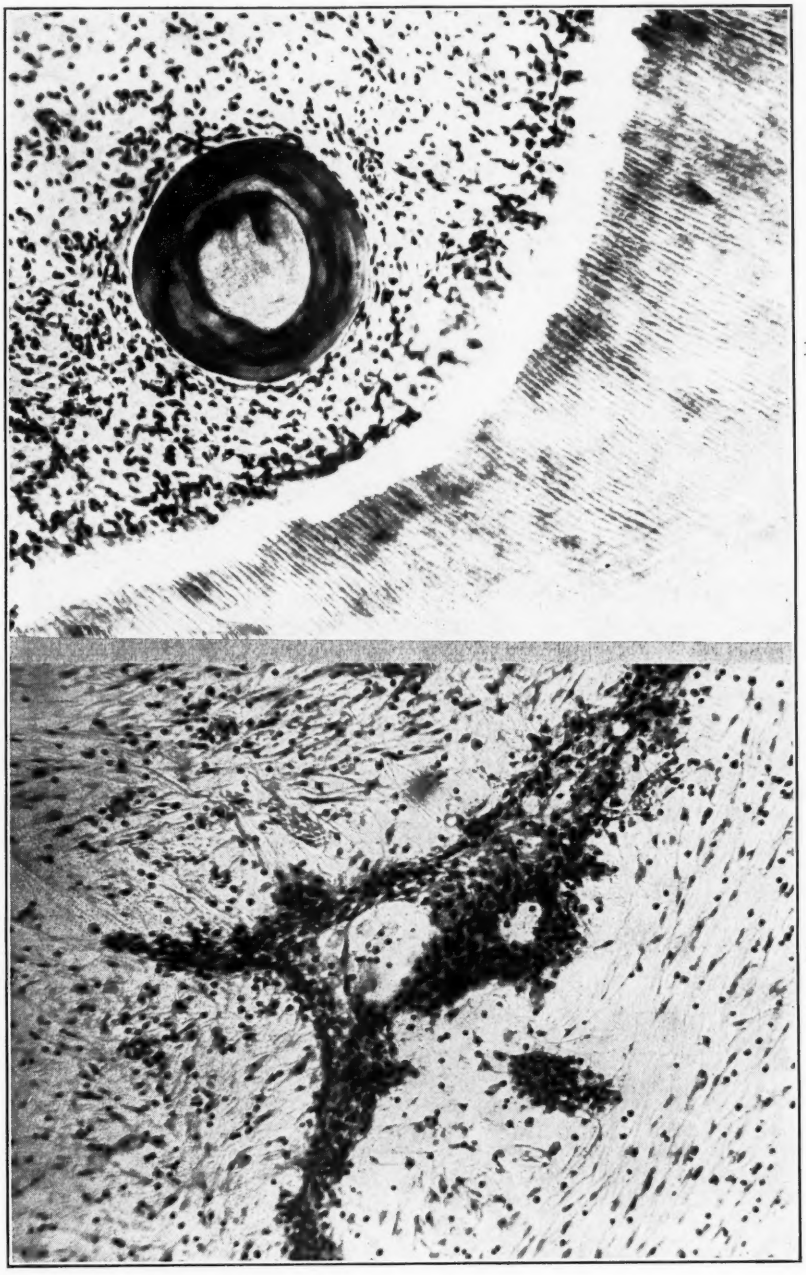

Fig. 18.

Fig. 19.

Fig. 18.—Pulp stone in four-month-old infant's deciduous tooth (×65).
Fig. 19.—Undifferentiated endothelial cell mass and cellular exudate in pulp tissue (×65).

pink staining osteoid tissue with tubules were observed in the most apical portion of the pulp tissue. This osteodentin was not connected with the dentin of the tooth in the sections studied.

c. *Supporting Tissues.* The mucous membrane covering the jaws was not unusual. The cortical bone contained numerous deep purple staining irregular-shaped areas which suggested previous bone resorption and repair. The periosteum appeared slightly thickened. A structure, probably a lymph node, was observed in the younger infant beneath the angle of the mandible which contained numerous areas of central necrosis resembling caseation, but no giant cells were observed.

COMMENT

Few histopathologic studies of the dental structures in congenital syphilis have been made. Karnosh has shown clearly by means of ground sections the abnormalities which occur in the enamel of the permanent series, especially the first permanent molar. The enamel changes I observed in the developing first permanent molar resemble closely Karnosh's findings on fully erupted teeth where the enamel substance was lacking or deficient in amount over the dentinal cusps. These enamel organ changes are similar to those described by Addison and Appleton[23] as occurring normally in rat molars.

Histologic studies on the deciduous teeth in congenital syphilitic patients have not been discovered in the literature. Marked changes were observed in the dentin and pulp of the developing deciduous teeth which resembled those which Boyle[24] reported as occurring in vitamin A deficiency. Boyle's patient was a congenital syphilitic, and it is possible that the changes described, which resemble ours so closely, may have been due to syphilis and not to avitaminosis.

The diffuse calcific deposits and the perivascular round cell infiltrations in the pulp, as well as the alveolar bone changes, can be regarded as manifestations of a generalized infection with the *Treponema pallidum.* The more localized changes, such as the enamel hypoplasias, metaplasia or aplasia of the ameloblasts, could conceivably be produced by the local activity of the *Treponema pallidum.* The more common changes, however, were of a general nature which might better be explained on the basis of the interruption of the normal activity of highly specialized structures by serious infection.

Spirochetes could not be demonstrated in the dental tissues, and it is problematic whether they act directly or specifically on the dental tissues in the production of the dental anomalies commonly associated with congenital syphilis.

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ACTINOMYCOSIS OF THE JAWS AND DISEASES WITH SIMILAR SYMPTOMS

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THE outstanding significance of actinomycosis as a chronic infection is beyond dispute. Its paramount importance for the dental practitioner is borne out by the statistical fact that nearly 60 per cent of all actinomycosis cases occur within the region of the head and neck. The very consideration of these numerical findings should force upon the dentist the serious thought that he must be intimately acquainted with the early symptoms of this disease.

For solely, the prompt recognition of this very dangerous disease at the right moment will prevent those sad cases which often end in death as a result of an overlooked or mistaken diagnosis.

It must be readily admitted that it is not always an easy task to diagnose correctly an incipient case of actinomycosis of the gums, particularly one still hidden from external observation. And, even in open cases, there are often so many other diseases with similar symptoms in which finally only the medium of a microscope and the assistance of an experienced bacteriologist may shed light into the darkness of diagnostic uncertainties.

It is, therefore, the purpose of this paper to outline briefly the symptoms of actinomycosis of the jaws and to consider all the other diseases which are of differential diagnostic value for its detection.

Actinomycosis is caused by an organism which belongs to the class of actinomycetales. (Classification adapted from Bergey's Manual, 1930.) In Europe it is called *Actinomyces Bostroem*, in America *Actinomyces bovis*. Bollinger,[1] Harz, Bostroem,[2] Ponfick, Israel and Wolff were the first who described the bacteriology and pathology of the *Actinomyces bovis*.

It is usually found as a parasite on grass and grain, also in forest soil, and sometimes in warm springs; even in the alimentary canals of larval insects it has been found living. There are about forty different species known, partly aerobe, partly anaerobe, not all of them being pathogenic. They belong to the same group as the leptotrichia and the streptotrichia; therefore one is very often mistaken for the other.

Bostroem succeeded in proving the penetration of the actinomyces into human or animal tissues by means of awns, beards and straws, especially when they are dry and stiff. Lesions are not contagious from men to men or from animals to men (for instance by drinking milk from cows which have actinomycosis).

On some sorts of grain, especially on awns of barley, actinomyces exist in form of saprophytes without causing diseases of the grain. It is therefore very difficult to recognize infected grain and fodder. This is one of the main reasons that in some rural districts in which the actinomyces have contami-

Graduation Thesis, Class of 1937, School of Dentistry, University of Pennsylvania.

nated the grain, actinomycosis can be found more frequently than among the urban population. The commonest cause of an infection among the rural population results from the bad habit of chewing infected grain, whereby lesions of the gingival tissue and penetration of the actinomyces into the tissue may occur.

The actinomyces is able to live in the oral cavity in form of saprophytes for a long time, and if not transmitted into the tissue by mechanical lesion of beards, it may penetrate into a granulation caused by broken-down teeth, sharp edges of dentures, or toothpicks. Under favorable conditions a typical actinomycotic granulation tissue may be formed which will extend constantly into the surrounding areas. The clinical picture of this process will show a diffuse, boardlike, hard swelling of the infected soft parts and a vivid bluish red discoloration of the covering skin. The true picture will be obtained when there are swellings of the skin caused by infiltration and abscess formation, side by side with contractions and scar formation,[3] and when multiple fistulas are formed. Fever or pains usually are present in case of a mixed infection. If the muscles of mastication or of the floor of the mouth are included in the infection, lockjaw or difficulties in swallowing may arise. From the viewpoint of the differential diagnosis it is very important to know that the lymph glands are not swollen.[4]

At such a late stage in the development of the disease as described before, the diagnosis of actinomycosis is obvious and will be finally assured by the examination of the pus and the granulation tissue. The pus contains small yellow gritty granules with chestnut-bur-like colonies consisting of branched threads, occasionally with very slightly clubbed ends.[5] Macroscopically the organisms are seen as small soft yellow granules resembling small grains of sulphur. For a microscopical examination it is necessary to treat them with sodium or potassium hydroxide. The fungi grow best at a temperature of 30° to 37° on various culture media under anaerobic conditions, they are gram-positive but not acid-fast. Oscar Israel was the first one who succeeded in culturing the fungi in a pure form on beef serum. Today bacteriologic cultures usually are made by transplanting diseased material directly from men to artificial anaerobe culture medium in order to prevent injury to the germs by the oxygen of the air.

The pathogenic actinomyces type Bostroem is a facultative anaerobe. The fungus forms a proteolytic ferment and a hemolysin. The latter formation does not occur regularly as it does in other bacteria, and it is in no relationship to the pathogenicity of the fungus.

In order to ascertain the pathogenicity of the fungus, men and animals were inoculated either with diseased material such as pus or tissue parts, or with the cultured germ itself. Wolff and Israel reported some very interesting experiments. They were able to produce tumors as large as hazelnuts by means of inoculating intraperitoneally anaerobe actinomyces cultures into guinea pigs and rabbits which showed the characteristic "drusen" formation. These experiments, however, were of no clinical value, because the actinomyces cultures developed later into a saprophytic state and the infection came clinically and bacteriologically to a rest and even retrograded.

The best known and most sought for pathogenic actinomyces species is the *Actinomyces Bostroem* which usually forms drusen and threads, and the Wolff-Israel actinomyces which forms short rods. The first species is usually responsible for actinomycosis in men and animals. The opinion of Shiota who claims that at least two different species of the actinomyces group cause actinomycosis has not been recognized yet.

Some authors claim that there are not only differences in the form and the pathogenicity of the fungus, but that there are also different clinical forms and types of actinomycosis. Berestnew[6] describes an atypic form, as he calls it, of actinomycosis in which no formation of small yellow gritty granules occurs. Berestnew reports, in addition to this atypic type, cases of a so-called pseudo-actinomycosis, with the same symptoms as the typical actinomycosis which he divided into two groups:

A. To the first group belong different microbes which are gram-positive. Some of these bacteria have the ability, similar to the tubercle bacillus, to change into fungi with long, sometimes branchy threads with club-like knots at their extremities. Diagnosis is possible only after a very thorough bacteriologic examination.

B. The second group is composed of different gram-negative bacteria and, therefore, the differential diagnosis meets with no difficulties.

The dominant occurrence of actinomycosis around the head and neck is a proved fact, and the oral cavity undoubtedly forms the main focus. The actinomyces is found very often in decayed or diseased teeth, in extraction wounds, in the gingival pocket around an impacted wisdom tooth, and in the gingival pockets present in gingivitis or paradontosis. The fungus may also infect the jaw bones, the salivary glands, the tongue, the pharynx and larynx, besides the gingiva.

It is impossible to make a differentiation between the actinomycosis of the soft tissues around the neck and that of the jaws, because they usually occur together or the primary focus has already retrograded so far that it cannot be located any longer.

Actinomycosis of the jaws is usually more dangerous than that of other bones. In the skeletal bones the infection is exclusively a secondary one. Here an actinomycosis of the external soft tissues or the inner organs may spread over the periosteum into the cortex of the bone and sometimes even into the spongiosa. Actinomycosis of the long medullary bones by way of the blood stream has also been reported. The infection of the jaw bones ordinarily is a primary one because the fungus may easily migrate through the root canals or through the gingival pockets directly into the bone and may extend into the bone marrow.

Actinomycosis of the jaws can be divided into a peripheral and a central form.

The peripheral form of actinomycosis undoubtedly is an infection of the bone, starting from an actinomycosis of the periosteum or the soft tissues. The infection usually forms an abscess which penetrates the corticalis and causes erosions. Cases of this kind are rare and occur more often in the mandible. The destructions of the bone caused by this type of actinomycosis

are not very extensive. Quenet and Pordes reported a few cases in which larger parts of the jaw became infected.[7] In the instance of Quenet a serious case of actinomycosis of the maxilla was diagnosed as a luetic necrosis because the symptoms were so strikingly similar. It was only the discovery of the drusen that helped to correct the diagnosis.

Fessler and Poncet observed and reported for the first time a strange and rare change in the mandible, hyperostosis, caused by the actinomycosis infection of the periosteum.[7] In these cases the mandible was thickened to such an extent that a sarcoma was diagnosed and the mandible was resected. The histologic examination after the resection showed small actinomycotic foci with fistula formations leading into the bone tumor. In the case of Poncet the ascending part of the mandible was converted into a large solid mass of bone. On the surface there were numerous irregular cavities next to small bone tumors. The interior of the bone was a hard ivory-like mass. A similar case was reported by Jorge, in which actinomycosis caused a neoplastic osteoperiostitis of the ramus ascendens of the mandible.[7] It was necessary to remove the diseased part by a resection. In all these cases the fungus was found in the granulation tissue and in the pus, but not in the newly formed bone. Jorge also found only mycelium in the bone.

The central actinomycosis of the jaws usually occurs only in the mandible and is very rare in men. It is encountered frequently in animals, especially in cattle. The central caries actinomycotica of the mandible was observed by Israel, Murphy and Fevrier.[7]

With central caries the bone shows cavities of different sizes which are filled with actinomycotic granulation tissue. These cystic cavities begin to grow slowly, the bone becomes enlarged and the wall finally so thin that fractures may easily occur.

The central new formation, on the other hand, or the "actinomycom" as called by Bruns,[8] is a productive inflammation which is similar to a genuine tumor. This form of actinomycosis has been reported so far only in the mandible and is very similar to the actinomycosis in cattle. Cases reported by Jaehn, Ducor-Poncet and Klingsbigl show the characteristic picture of an actinomycom.[7] Jaehn published a case of a single cyst the size of a cherry that was formed in the alveolar process between the roots of two bicuspids surrounded by a compacted mass of bone.

The external bone wall was removed because a tumor was suspected, and a cavity was discovered lined with a peculiar looking, easy tearing sack. A biopsy showed the actinomyces fungus.

In Ducon-Poncet's case there was found in its more advanced stage a marked swelling and enlargement of the mandible, but the surrounding soft tissues were not in any way affected. When the bone was opened, a complex of cystic cavities was discovered which were separated from each other by fibrous septa. The cavities contained actinomycotic granulation tissue and an opalescent fluid of gelatin-like consistency.

In the case of Klingsbigl only a single cyst was found which was surrounded by a very thin layer of bone.

These many different forms in the occurrence of actinomycosis very often give rise to an incorrect diagnosis. First of all, a common infection may be

diagnosed in a case of peripheral actinomycosis which presents itself in the form of a mixed infection with actinomyces and pyogenic and gangrenous bacteria. The process is acute with fever. Pain is always present or may spontaneously arise when touching the infected and inflamed area. After the lapse of a few days an abscess is formed which may be localized either in the mandible or in the maxilla. All these cases have in common the following symptoms with the simple pyogenic infection: the abscess is formed in a relatively short time and there is but one abscess formed in the center of the inflammation. After the incision of the abscess, the temperature drops, the infiltration decreases, and the edema of the surrounding tissue disappears. The bacteriologic examination of the pus shows the same bacteria as in nonspecific infections, a mixture of pyogenic and gangrenous bacteria. The actinomyces are not detected immediately in the young culture because the other bacteria growing in such an abundance, overgrow the fungi to an extent that they appear only by chance on the slide. The thought of a possible actinomycosis does not enter one's mind because all the clinical symptoms do not indicate such a disease. Soon, however, the picture changes. Whereas in common abscesses the infiltration will decrease and disappear after some time, in an actinomycosis, part of the infiltration will persist or the induration of the soft tissues will proceed on account of the present fungi. The entire cheek, the submental region or the maxillary region may be infected in the same way. The skin of those regions is discolored and appears dark red or blue red. The most striking fact, however, is that there exists a normal or only slightly raised temperature and that the patient's health shows no upset condition. Not before some time has elapsed, will the typical and already discussed picture of actinomycosis develop.

The same picture or one similar to the mixed infected form of actinomycosis may be caused by a phlegmon or osteomyelitis. The suspicion of an osteomyelitis is strengthened by the presence of lockjaw and the rapid variations of temperature. Taking into consideration, however, the patient's very low state of health in case of phlegmon or osteomyelitis, the chills, the large swelling of the soft tissues and the lymph glands which are extremely sensible to pressure—bearing all this in mind it should not be difficult to diagnose osteomyelitis especially after a bacteriologic examination of the pus for the presence of staphylococci and streptococci has been made.

It is not unusual that at times an osteomyelitis sicca may be diagnosed in a case of actinomycosis. This form of osteomyelitis is usually a dry necrosing one accompanied by hypertrophy of the bone. The pain seems to be inside the jaw bone, very often in the teeth, and is accompanied by a swelling of the soft tissues. Frequently no discharge of pus will occur. Likewise as in actinomycosis the patient does not feel sick, so to speak, as he is still able to go about his daily tasks. Here the biopsy shows small cavities and granulation tissue in the affected bone. A large amount of newly formed bone may be found, much more so than dead bone. The chronologic occurrence of necrosis of old bone and formation of new bone differentiates this chronic necrotic type of osteomyelitis from the acute osteomyelitis as well as from actinomycosis.

Occasionally it might happen that an arthritis of the mandibular joint may be taken for lockjaw caused by an actinomycosis located at the angle and the ramus ascendens of the mandible. In a casual picture of that sort, it may suffice to remember that an isolated disease of the mandibular joint is very rare and is usually brought about by an acute rheumatic fever. Of further diagnostic importance is the prompt reaction of such cases to doses of salicylic acid and to diathermy, which treatment certainly would spell no success in an existent actinomycosis.

It is of greatest diagnostic value to know that the actinomyces may also cause a specific periodontitis. The "periodontitis actinomycotica" has at the beginning the same symptoms as a common periodontitis, but there are a few characteristics which may arouse the suspicion of a specific periodontitis. Here the symptoms usually do not disappear after the extraction of the tooth, the periosteal swelling does not decrease, and lockjaw may still exist even though the wound has already healed. If a ripe abscess is going to rupture through the skin, it does not appear at the side of the periodontitis but fistulas may form, scattered all over the face. Only the examination of the pus and the findings of the typical drusen will lead to the right diagnosis. Zilz[9] reported a case in which an actinomycotic granuloma at the root was formed and from that source the soft tissues of the cheek became infected.

The clinical picture as well as the x-ray examination of a central actinomycosis may very often mislead the medical observer, and at times he is tempted to diagnose it as a cyst or an adamantinoma. All three types usually take a long time to develop. Pordes described the roentgenogram of an actinomycotic mandible in the following words: "One gets the impression that the mandible has been broken up into many small particles which have been composed again and then placed into an acid which started to dissolve the different particles but without destroying the external form. It seems as if the particles are swimming in a vacuum. The connections are dissolved, the margin of the mandible is divided into oblong parts. These parts have soft contours and do not show any structure. The calcium content is decreased. The external outline of the normal mandible is nowhere interrupted or changed. There are no traces of periosteal apposition or reparative or regenerative processes."

In such doubtful cases the final diagnosis may be obtained by a biopsy of the contents of the cavities. Either the presence of the typical yellow cholesterin crystals or the presence of fungi will prove the diagnosis of a cyst or of an actinomycosis.

Osteitis fibrosa must also be considered for the differential diagnosis of the actinomycosis of the jaws in which case only the biopsy will bring the solution. If there is a fibrous tissue which contains more or less numerous giant cells and which has a very rich capillary net and resembles a chronic granulation tissue, then the diagnosis of an osteitis fibrosa is justified.[10]

If the patient has anything to do with phosphorus in his profession, phosphornecrosis of the bone has to be considered and excluded before actinomycosis of the jaws may be diagnosticated. The difference can be

easily detected because in a case of phosphornecrosis, the whole organism and the skeleton is affected, whereas in a case of actinomycosis only a local form of the disease usually occurs.

Very difficult are those cases in which the suspicion of a central actinomycosis, on the one hand, and of an osteosarcoma or carcinoma, on the other hand, is equally strong. It is absolutely important to arrive at an early correct diagnosis because of the great danger of metastasis of these tumors (sarcoma mostly by the way of the blood vessels, carcinoma by the way of the lymphatic vessels) and their tendency of destructive growth.

The diagnosis of sarcoma may be facilitated if the tumor is located around the eye; but, if it is located in the maxillary sinus or in the fossa pterygopalatina, it will become very difficult to give a correct diagnosis. Serious hemorrhages and persistent nasal catarrhs are suspicious signs of a sarcoma. As long as the tumor is hidden in the sinus, these symptoms associated with a clear shadow on the x-ray picture and an abnormal sensibility to pressure in the face or around the head, may be the only signs. The eruption of the tumor toward the maxilla or the nose will clarify the diagnosis.

The great variety of histologic forms of sarcoma is known and is also present in those forms around the jaw. There are giant cell sarcoma, chondrosarcoma, fibrosarcoma, and myxosarcoma. A biopsy will aid in the right diagnosis.

Regarding the diagnosis of carcinoma it must be borne in mind that carcinoma is an epithelial formation, an important fact to be considered in the diagnosis. Within the region of the jaws it is primarily the epithelium of the glands and also the epithelium of the antrum and nasal cavity that must be thought of. There are to be found in this section primary and secondary carcinomas and very rarely metastatic carcinomas.

A carcinoma may also arise from the epithelium of the gingiva in the oral cavity. It usually appears as a papillary tumor or more often as an ulcer with hard elevated walls. The ulcer will soon become necrotic and will penetrate the bone, which seems to be thickened and softened. Necrosis of the bone and expulsion of small sequestrums are not at all rare.

The central carcinoma originates primarily in the interior of the maxilla, at the mucous lining of the antrum. But there are cases in which the carcinoma originated from the sphenoidal, ethmoidal, or nasal bone.

The formation of genuine central carcinomas of the mandible without participation of the gingiva and the mucous membrane is unknown. Usually the carcinoma starts as an ulcer of the gingiva, which soon broadens and grows into the bone. The ulcer will necrose early and aided by the bacterial flora of the mouth will produce a strong fetor ex ore. Relatively early the carcinoma may spread over the mucous membrane of the cheek and penetrate the soft tissue rendering radical operation impossible.

Carcinomas which originate in the neighborhood of the jaws and cause secondary carcinoma of the jaws are characterized by a greater swelling with participation of the soft tissues. They will later develop into ulcerative processes which will open into the mouth or to the outside of the face. They usually form large compact tumors, the necrosis of which creates deep crater-like ulcers.

It is of differential diagnostic importance that in cases of carcinoma of the jaw, regardless of whether it is a primary or secondary tumor, the tongue is deprived of its motility and mastication and speech are very much disturbed.

The teeth play a great rôle in the infection of actinomyces as well as in luetic infection or tuberculosis. There is also the possibility that the gingiva is injured by sharp margins of cavities, by extractions or by dentition and thus may be infected with tubercle bacilli. This is a striking analogy to the mechanism of infection in actinomycosis.

It is not at all easy to differentiate between a tuberculous parulis and a nonspecific pyogenic or a specific actinomycotic parulis. Only the typical undermined bluish red walls of the remaining fistula of a tuberculous ulcer will give a correct diagnosis. In contrast to the periodontitis actinomycotica, the submaxillary lymph glands and those of the upper part of the neck are always swollen.

Besides the direct or primary tuberculosis of the jaw, there may occur a tuberculous infection through the blood stream. This form is more frequent than that which occurs from the teeth, and is most frequently found in younger individuals.

The seat of a tuberculous infection in the maxilla is usually at the lower orbital margin where a cold abscess forms which sometimes expels small sequestrums. After the healing of the tuberculous focus, a scar will remain that is typical of the infection and is easily recognized.

Tuberculosis of the mandible, mostly a disease of the younger individuals, begins with a slow and painless swelling. Gradually the swollen section will soften at one spot, and fistulas may form at different places, mainly at the lateral side of the jaw in front of the ear and in the mandibular region downward to the neck. If the foci are located near the alveolar process, fistulas may lead into the mouth. This form of tuberculosis may destroy large parts of the bone and is considered very serious.

The symptoms of value for the differential diagnosis with actinomycosis are: the road of infection through the blood vessels, the large swelling of the regional lymph glands, the typical margins of the ulcer, and the finding of tubercle bacilli.

In regard to syphilis, its third stage must be chiefly taken into consideration in the differential diagnosis with actinomycosis. The commonest sight is the gumma at the hard palate. It may happen that a gumma which originated at the floor of the nose may break through the hard palate. The gumma is such a characteristic symptom of syphilis and has so many characteristic signs that it can easily be diagnosed. It seldom occurs at the orbital margin or at the external surface of the maxilla.

Larger destructions than those caused by single gummas may be caused by a diffuse gummatous osteitis. The teeth are usually loosened and the alveolar process begins to necrose. The teeth are also of some importance in luetic infections. Port reported a case in which syphilis began with periodontic symptoms in an incisor and fistulas were formed.

Only the Wassermann test and the favorable influence of salvarsan treatment upon the disease will determine the correct diagnosis.

The striking similarity of actinomycosis of the jaws with the different diseases just discussed shows the great difficulties the clinician may meet when striving for a correct diagnosis of this disease. Only a profound knowledge of the symptoms and the forms of these diseases and the histologic and bacteriologic examination may prevent a wrong diagnosis. There are also, however, diseases similar to actinomycosis not only from the clinical but also from the bacteriologic viewpoint.

Streptotrichosis and leptotrichosis are diseases caused by germs with the same names. They belong to the same group of bacteria as the actinomyces and will therefore be discussed together.

Both organisms as the actinomyces fungus often are present in the mouth as saprophytes. The leptotrichia usually hide in the crypts of the tonsils and are found sometimes in the respiratory organs. It is important for the clinician to note that leptotrichia form thick, long, straight or curved filaments, unbranched, frequently clubbed at one end and tapering at the other. The streptotrichia form true branches but no drusen. Actinomyces has radiating threads and forms drusen. The pathologic lesions of all three bacteria are similar. Granulation tissue is formed which extends slowly into the intramuscular connective tissue. The bone can be changed, too. In the biopsy the actinomyces drusen are easy to be found, but the detection of the two other germs meets with great difficulties.

The clinical picture caused by leptotrichia and streptotrichia is the same as that of the typical actinomycosis. Only an exact bacteriologic examination with consideration of the morphologic peculiarities of the different bacteria may prevent confusion among these diseases.

Sporotrichosis is a disease of comparatively recent date. It usually appears as a cutaneous manifestation, but it is by no means exclusively confined to the skin. There is a disseminated gummatous form in which multiple subcutaneous nodules appear. They soften later and form large cold abscesses. Another form is the disseminated ulcerative sporotrichosis and is characterized by multiple polymorphic ulcerations resembling tuberculous, syphilitic or furuncular lesions. The last form is that affecting the extracutaneous tissues. The lesion may be localized in the bones, joints, muscles, kidneys, etc. The disease is caused by the *Sporotrichum schencki* and has a rather wide distribution in nature. Microscopically the lesions are granulomatous with a necrotic center usually surrounded by a zone of dense cellular infiltration. The sporotrichum may cause peripheric changes at the bones in form of a fibrous periostitis, or may form central in the bone marrow located foci. The central abscess may destroy the bone substance and cause spontaneous fractures. Differentiation between actinomycosis and sporotrichosis is possible only by finding the sporotrichum in the bacteriologic examination.[9, 11]

Blastomycosis is a term used to designate all diseases produced by blastomyces, which are budding fungi or fungi with a yeastlike form. It may be caused by various species of the genera monilia, cryptococcus, mycoderma, etc. Characteristic of the disease is the formation of ulcers. The ulcer is round, has a sharp festooned wall which is higher than the ulcer but which seems to be infiltrated only slightly. The wall is undermined and the skin is discolored.

The ulcer is flat and its floor is very sensitive to touch with an instrument. The ulcer secretes a viscid, coherent, reddish transparent secretion which contains small gray particles. It very seldom occurs in the mouth and, if it does, it resembles very much actinomycosis, and can be differentiated only by the findings of the yeasts.[9, 11]

A brief survey of the different forms of actinomycosis in the region of the jaws may justify the conclusion that the actinomycosis remains unknown or is difficult to differentiate from other similar diseases only as long as the process is hidden in the bone and not visible to the eye of the clinician.

Of greatest importance in the diagnosis of actinomycosis is the microscopic examination of the pus. Also a biopsy may help to find the typical actinomyces drusen.

It should be mentioned here that recently the diagnostic means were enriched by some biologic procedures, which are of special interest in all those cases in which the symptoms are located at a place which cannot be reached by clinical and laboratory methods. The biologic reaction, of course, may be disturbed by group reactions which also occur with diseases caused by other fungi and it is, therefore, necessary to exclude these other diseases by means of different diagnostic methods.

Neuber[12] especially worked during the past few years on experiments of complement fixation and agglutination, but heretofore without any definite results. He obtained much better results with the specific allergic reactions which he worked out in relation to the differential diagnosis. Neuber used for the purpose of diagnosing actinomycosis a polyvalent actinomyces vaccine. He claims that the most reliable reactions are those which may be obtained when the vaccine is given intracutaneously. Local, focal, and general symptoms may arise, but the local and focal symptoms are of the most value for the diagnosis because the general symptoms are usually not distinct enough.

The question may be raised: Is actinomycosis of the jaws a rare or a frequently occurring disease? Just recently, Axhausen,[13] Bates,[14] Hayes[15] and Schupfer[16] reported very interesting facts about actinomycosis. They believe that it is a very common disease, and their opinion is based upon a considerable number of cases. Axhausen observed during nine months in one hospital no less than 26 cases of actinomycosis of the jaws. He rejects the general opinion of rare occurrence of actinomycosis with the argument that the disease at the beginning (das Fruehbild) is very difficult to diagnose and the therapeutic means usually employed on behalf of any other infection are sufficient to clear up the actinomycotic infection. But this is not always the case. If the treatment is not successful, the known picture of an advanced actinomycosis will develop.

Axhausen[17] gave the following opinion about the symptoms of an early actinomycosis of the gums and the correct and early diagnosis thereof:

"The early picture of actinomycosis of the jaws is exactly the same as that of a simple pyogenic infection in all its varieties. The actinomycosis is no independent disease. The condition for its occurrence is the primary pyogenic infection which opens the soft tissues to the penetration of the

drusen. Actinomycosis of the jaws is without exception a mixed pyogenic infection. The way of its entrance and its clinical early picture are determined by the pyogenic infection.

"Every acute or chronic submucous or perimandibular abscess may become infected by actinomyces without any other special symptoms. This may happen quite frequently in those common chronic abscesses of an apical periodontitis which will open through the skin. In no less than 28 per cent of cases of this kind, drusen could be detected in the granulation tissue. In these cases the clinical picture was that of a chronic pyogenic infection: the periodontic tooth, the apical focus, the connection to the soft tissue, no induration of the surrounding tissues, and no lockjaw.

"In all these cases of chronic pyogenic infection the accompanying drusen are confined to the local focus and have not yet penetrated the surrounding capsule of connective tissue. The usual radical operation of the pyogenic focus removes at the same time the accompanying actinomycosis. But there are no symptoms in the clinical picture that may show that this first stage of an actinomycotic infection has already been passed. In cases in which the drusen have already penetrated the borderline of the focus at the time of the operation, the success of a treatment will become very dubious. After the formation of a scar or sometimes during the granulation, one or more chronic subcutaneous abscesses may form in the surrounding tissue. Now the drusen are the leading factors in the picture of the disease. This is proved by the induration of the tissues which are located between the different abscesses. Further development will lead to the well-known picture of actinomycosis.

"The early picture of actinomycosis in an acute pyogenic infection is just as much hidden as in the chronic type. The actinomycotic mixed infection was detected in many cases of acute submucous and perimandibular abscesses, of osteomyelitic abscesses and in fractures without the appearance of any typical symptoms that may betray a specific infection. If the actinomycotic mixed infection is not detected, new acute abscesses will always form again in spite of the best care of the primary focus."

Axhausen claims therefore that it is absolutely necessary for the purpose of a correct and early diagnosis to carry out the following instructions:

Remove completely the focus of the disease even if the infection seems to be harmless. All granulation tissues should be examined microscopically. In case that the report of the biopsy is positive, the actinomycosis should be treated with x-rays. Every acute pyogenic focus should be carefully examined for the presence of drusen; this is best done under the microscope. If the result is positive, x-ray therapy is imperative. If the amount of pus diminishes, the presence of drusen and their examination become negative. It will, therefore, be advisable to watch the process of the disease and check the pus again after some days.

The danger of an overlooked or wrongly treated actinomycosis is different in either jaw. The most serious infection is usually in the upper jaw, even if the abscess is located only in the soft tissues. Advanced cases

are very difficult to treat, even surgically, and always cause a cosmetic disfiguration of the face. Once the abscess penetrates the bone, serious complications may arise and extensive bone destruction may follow. Spread of the disease into the antrum, orbit or into the brain may initiate meningitis or encephalitis and lead to death.

The lower jaw may become affected by actinomycosis beginning around the mental region and extending toward the ascending ramus. The lightest form of the disease is usually observed along the horizontal part of the mandible, but those cases originating at the angle and the ascending ramus become more serious on account of an eventual affection of the muscles of mastication and the concomitant lockjaw. The first signs of the beginning infection are toothache and genuine neuralgias. Other ways for an extension of the disease beginning in the mandibular region are toward the cheeks and the neck.

CONCLUSIONS

The two great groups of actinomycosis of the jaws are (a) peripheral actinomycosis and (b) central actinomycosis.

A common form of the first group is osteoperiostitis. There are three different forms of central actinomycosis of the jaws: (1) central caries actinomycotica, (2) actinomycom, and (3) periodontitis actinomycotica.

The following diseases have to be considered and excluded before one may arrive at the diagnosis of actinomycosis of the jaws: (1) pseudoactinomycosis (two different types), (2) common pyogenic infection, (3) osteomyelitis, (4) osteomyelitis sicca, (5) phlegmon, (6) arthritis of mandibular joint with lockjaw, (7) periodontitis, (8) cyst, (9) adamantinoma, (10) osteitis fibrosa, (11) phosphornecrosis, (12) sarcoma, (13) carcinoma, (14) tuberculosis, (15) third stage of syphilis, (16) streptotrichosis, (17) leptotrichosis, (18) sporotrichosis, and (19) blastomycosis.

Actinomycosis in the region of the jaws is not so rare as commonly thought. It may be detected quite frequently among the patients of a larger clinic or hospital with the necessary means and methods of examination.

The reason for the common belief in the rare occurrence of actinomycosis is that usually only the advanced cases are recognized as such, and the beginning cases are mostly hidden by a mixed infection and are recorded and treated accordingly as a mixed infection.

Moreover, the tendency of the early cases to respond favorably to the first treatment may add to the belief that it was a mixed infection.

Actinomycosis of the jaws is usually associated with a mixed infection of pyogenic germs, depending upon the way of penetration into the tissues, for instance through a gangrenous tooth, an ulcerated pocket of the gingiva or an ulcerated surface of the gingiva. It may even be assumed that the presence of the actinomyces may decrease the virulence of the other pathogenic bacteria.

It is absolutely right and justified to make a differentiation between the early state of actinomycosis (unauffaelliges Erstbild Axhausen's) and the late classical picture of the disease.

Suspicion of an actinomycotic infection may be awakened if, in spite of a radical surgical operation of an abscess, a new abscess suddenly forms in the neighborhood of the old one.

The frequent occurrence of actinomycosis accompanied by acute or chronic pyogenic infections necessarily implies examination of the pus and the granulation tissue bacteriologically and histologically in order to prevent a faulty diagnosis and to place the patient within the reach of correct therapy from the very start.

Considering all the possible serious consequences of actinomycosis of the jaws, early diagnosis of this infection is very important. Very often the dentist is the first who will have to diagnose such an infection. Knowing full well all the different symptoms and forms of actinomycosis of the jaws, and mastering the proper technique of a histologic and bacteriologic investigation, he will contribute much to combat this insidious disease.

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THE PRESENT-DAY CONCEPT OF CARIES BASED ON CLINICAL AND EXPERIMENTAL DATA AND THE MOST FRUITFUL APPROACH TO THE PREVENTION AND CONTROL OF THE CONDITION*

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THE control of dental caries has been the major problem of the dental profession throughout its existence. There is much literature based upon clinical observation and laboratory research that claims to reveal the cause and cure of dental caries; but, strange to say, the methods advocated are varied and the data substantiating them contradictory.

It is interesting to observe that in the latter part of the nineteenth century there was an analogous situation to that with which we are dealing today. A glance at Garretson's (1892) *A System of Dental Surgery* will give some idea of the methods advocated for the control of dental caries at that time. He says, "There is a constitutional treatment for the carious maxilla, and from a common standpoint are the diseases of both to be viewed." This author stressed the significance of those foods rich in calcium and phosphorus and intimated that the cure of dental caries was solely a matter of nutrition. He accepted dental deterioration as being more commonly associated with constitutional weakness than with any of the various local causes. He was cognizant of the changes in the hardness of dentin following the use of copper or oxychloride of zinc as a filling material, and he included in his text a picture of a section of a tooth in which an arrest of caries had occurred. These phenomena were alleged to be the result of a vital response on the part of the tooth to injury. The arguments propounded in regard to the response of dentin to injury in 1892 were also applied to enamel. They were based upon an understanding of enamel formation by the dental pulp with a resultant vital enamel theoretically capable of responding to injury in a manner analogous to dentin.

From this general background of observation, reason, and conjecture the deduction was made that the significant factor in the etiology of dental caries was a constitutional weakness on the part of the defense mechanism of the tooth followed by injury associated with local causes such as bacterial invasion, trauma, types of salivary fluids, and tooth arrangement. With these thoughts in mind Garretson stated, "The principles of the treatment of dental caries are: to relieve the part from the agent of offence, and to strengthen the resistive ability. The employment of gold as a tooth filling material wherever not contraindicated is favored."

In the present discussion an attempt will be made to outline the additions to our knowledge in this field and to evaluate the methods employed by critically reviewing the available literature. We shall pay particular attention to

*Read before the Massachusetts Dental Society, Boston, April 26, 1937.

the modern literature dealing with the control of dental caries by operative procedure and by nutritional means. The accumulated data shall be analyzed and the salient points interpreted in the light of our present knowledge or lack of knowledge of the natural history of the dental structures.

I hope to reveal from this analysis that it is extremely difficult to collect accurate data in regard to the efficacy of methods employed in the control of dental caries, and that additional knowledge of the natural history of the dental structures is necessary before we may accurately interpret the etiology of this disease.

REVIEW OF LITERATURE

We can make no attempt to evaluate the literature dealing with this subject without first considering the available knowledge concerning the anatomical, physiologic and environmental characteristics of the dental structures.

Bacteriologic Studies

The Michigan Group (1933) have been particularly interested in the relation of bacillus acidophilus to dental caries. Bunting says, "The only differential characteristic thus far observed between caries-free and caries-susceptible persons having a high degree of correlation is the relative number of *B. acidophilus* organisms in the mouth. Diet, it seems, controls dental caries through the determination of the environment of the teeth, rather than through changes in the resistance of the tooth itself."

Extensive studies on the relation of the debris on the surface of the tooth to dental caries have been made by Bibby (1935). It is his opinion that many types of bacteria may initiate the process of tooth decalcification, although *Lactobacillus acidophilus* usually predominates in the later stages.

Kligler (1915) presented an extensive and detailed study of oral microorganisms. He used a quantitative method, "with material scraped from tooth surfaces of caries susceptibles and immunes, deducing that *B. acidophilus*, *Cladothrix placoides* and the *Leptothrix buccalis* were the most significant with relation to dental caries."

Fish (1932) after making extensive investigations in the physiology of dentin and its possibile relation to dental caries emphasized the possibility of *Streptococcus mutans* as an etiologic agent.

Johnston, Kaake and Agnew (1932) report that in thirty rats held on deficient diets and exhibiting caries at autopsy, twenty-seven had a high lactobacillus incidence; and that of one hundred and fifty-three noncarious rats, one hundred and nine had a high lactobacillus incidence. In children having no caries a similar high aciduric count was noted. They concluded that *L. acidophilus* is not essential to caries and that there is no consistent correlation between the organism and tooth decay.

There is an evident lack of agreement between the authors quoted in the foregoing paragraphs in regard to the rôle played by *Lactobacillus acidophilus* as an etiologic agent in dental caries.

Salivary Studies

A critical review of the literature dealing with the relation of changes in the saliva to the etiology of dental caries was published by Becks and Wainwright (1934). They are of the opinion that no standard values for mixed saliva have ever been established.

Histologic Studies

J. Leon Williams (1932) states after a lifetime of study, "Not an iota of evidence has ever been presented that there is any circulation of nutrient matters in enamel, and even if there were, there are no formative cells to convert these nutrient matters into enamel, as all of the cells have completely disappeared by being converted into enamel rods. As a matter of fact, no one knows today what the normal or best form of enamel is or if, strictly speaking, there is any such thing. But certain it is that no enamel was ever formed that could withstand the destructive action of lactic acid. If we ever succeed in controlling the decay of human teeth, it will be not by changing the structure of the teeth, at least not primarily, but by inhibiting the action of acid-forming bacteria. I believe this may be possible through a change in the chemical constituents of the saliva brought about by scientifically arranged diet or by some other means."

Williams refers to the work of G. V. Black (1896) who states, "These classifications, therefore, show conclusively that neither the density of the teeth nor the percentage of lime-salts they contain has anything to do with the liability of the teeth to suffer from caries. Caries of the teeth is not dependent upon any conditions of the tissues of the teeth, but on conditions of their environment."

Bödecker (1930) says, "I believe that the mineral content of the enamel may be increased from the interior and probably from the exterior. I believe that the natural process of furnishing enamel with sufficient mineral matter is from the interior; i.e., via the pulp."

In a panel discussion on dental caries conducted before the fourth annual meeting of the American Academy of Pediatrics in 1934, Beust stated that "Oral environment has obviously nothing to do with caries incidence. The occurrence of vital phenomena within the dentin can no longer be questioned. Howard Mummery (1926), English histologist, showed zones of resistance surrounding incipient enamel caries."

Although a few investigators are of the opinion that caries may be controlled through defense mechanisms in the tooth activated by dietary means, it is evident that our foremost histologists have not been able to demonstrate satisfactorily that enamel is a vital tissue.

Physicochemical Studies

Hodge (1933) while studying the microhardness of teeth found that "in zones of infected dentin hardness values were comparatively low. Whereas passing from the zone of active caries into the infected dentin a thin wall was noted whose hardness was almost twice the hardness of normal healthy dentin."

In a report on the velocity of solubility of various samples of dental enamel Kanthak (1934) says, "Comparison was made of velocity of solution, and total Ca and P contents of powdered, dried enamel from teeth of individuals of various ages—6 to 67 years. The results indicate that, within narrow limits, the Ca and P contents of human enamel are quite uniform, and the rate of solution and the Ca:P ratio bear no apparent relationship to age or state of the teeth."

The comparative scarcity of data dealing with the physicochemical characteristics of the teeth and the possible relationship of these characteristics to the occurrence of caries indicate that additional study in this field is necessary.

Nutritional Studies

The teeth of rats in McCollum's colony were examined grossly by Grieves in 1922. "Caries-like" lesions were found in some of the teeth of 22 per cent of the rats fed a diet low in calcium. No lesions were observed in the teeth of rats fed the normal stock diet. The discovery of lesions in the teeth of rats resembling, more or less, the carious lesions seen in the teeth of man precipitated extensive studies in many laboratories.

From an analysis of the available data and his studies upon large numbers of rats fed various diets in McCollum's colony, Klein (1932) suggested that diets low in phosphorus favored the production of "caries-like" lesions in rats. He also found lesions, however, in stock rats fed the normal diet.

Shelling (1933), who also worked at Johns Hopkins University on the experimental production of dental caries in rats, states: "(1) Caries is infrequent in rats below the age of one hundred days, irrespective of the diet. (2) The incidence of caries is high in rats on diets containing a large percentage of coarsely ground corn, and absent on diets composed of casein and starch, or of grains the particles of which are finer and softer than corn. (3) In the rat there is no correlation between the Ca and P intakes, the concentrations of Ca and inorganic P of the serum, and caries-immunity and caries-susceptibility. (4) Since the caries-like lesions in the rat were probably due to physical injury by corn particles in the diet, the efficacy of vitamin D in preventing tooth decay cannot be evaluated from such experiments. (5) Results on the experimental production by this means of caries-like lesions in rats are not necessarily applicable to the etiology of dental caries in human beings."

In the rats studied at Yale University School of Medicine (1935) the following results were obtained:

The changes in the rats fed the low salt diet were: marked rarefaction of the alveolar bone, and increase in the adipose tissue of the bone marrow, irregular dentin formation particularly in the cusps and carious cavities in some of the cusps in which wear involved the irregular dentin.

The alterations associated with realimentation were: rebuilding of the osseous structure and formation of tubular secondary dentin.

Extraction of the maxillary right first and second molars was associated with a lack of attrition of all the cusps of the mandibular right first molars and

the mesial cusps of the maxillary right third were markedly shortened by wear. Changes in the pulps were particularly marked in the mandibular right first and second molars. Structural alterations of the alveolar processes and ulcerations with necrosis of the gingivae were marked on the right side. The changes of pulp, bone and gingivae were more severe in the rats fed the low salt diet. Carious lesions were seen in the cusps of some of the mandibular right first and second molars as well as other teeth in these rats. No correlation was found between caries activity and nutritional regime.

Agnew and Agnew (1933) described lesions occurring in the teeth of rats fed diets low in phosphorus and vitamin D. Examination of histologic preparations of the teeth led these workers to conclude that the lesions observed were typical dental caries. As no lesions were found in the control rats fed normal diets, the lack of vitamin D and phosphorus supposedly caused the lesions.

In Marshall's (1927) experience rats deprived of vitamin A developed dental caries after maturity was reached. It was not possible to alter or arrest the caries by changing the diet. Caries was not found in young animals. The lesions produced were similar to those found in adult man.

"Caries-like" lesions also occurred in the teeth of rats studied by Bunting (1925) who suggested that nutritional disturbances might influence caries by an alteration of the oral environment which regulates bacterial activity in the mouth rather than through structural changes in the affected teeth.

Lyons (1935) suggests that the antibiotic relationships of the oral flora are important factors in causing or in preventing dental decay. He says every question which has been raised regarding the bacterial theory of dental decay can be answered by such theory.

Shibata (1929) described the occurrence of lesions in the sulci of the teeth of young rats fed diets of rice and greens mixed with sugars. In his opinion the more adhesive sugars were the predominating factor in producing the lesions.

The relation of high sugar diets and dental caries in the white rat has been studied by Day (1935), who obtained the following results: "A high-sugar intake would not seem to be conducive to a high-caries incidence in the rat, even when the ration is fed in highly sticky and adhesive state. It is believed that sufficient of the well-balanced basal ration was consumed to ensure a sufficiency of minerals and vitamins even in the high-sugar groups receiving no supplements of these food factors and that this was responsible for the almost complete immunity to dental decay in this series."

Lesions were observed in the sulci of rats' teeth fed stock rations by Hoppert (1932) in which the cornmeal in the ration was coarsely ground. When the cornmeal was finely ground or replaced by oatmeal, the lesions were not found. In Rosebury's (1933) experience the lesions appeared at an older age in rats fed adequate diets, and no lesions were found in the teeth of rats fed diets in which the foodstuffs were cooked or finely ground. He suggested that fissure caries might result from the forcible impaction of large particles into the molar fissures. The sulci lesion was considered to be histologically similar to fissure caries in man, and he believed that a working assumption of their interrelationship was warranted by this similarity.

Several facts are outstanding in the mass of material outlined in the foregoing paragraphs. Lesions called "caries-like" or "rat caries" occur in the teeth of rats fed adequate or deficient diets. These lesions were not usually found in rats fed cooked or very finely ground diets. One explanation of these facts is that the coarse particles become impacted in the molar fissures and favor the production of lesions found in this position. Lesions occurred, however, in teeth of rats studied in our laboratories that were exposed only to synthetic diets that passed a 60 mesh screen. The exact mechanism by which the changes are brought about is not clearly understood.

Studies by Elliot (1933) begun in 1923 are interesting. During a three-year period 480 infants were followed from the time the birth certificate was filed until they had reached, in most cases, the age of 12 to 36 months. During this period antirachitic treatment was given in the form of cod liver oil and sun baths. In addition, there were examined over 1,000 infants and young children who had received no cod liver oil or essentially none, and no sun baths previous to examination. Follow-up examinations were made eight years later of children chosen from the two groups. In order that the results might show as sharp contrasts as possible, effort was made to reexamine first a group of children who had received the most intensive antirachitic treatment and who were known, because of frequent roentgenologic examinations during the first year or two of life, to have been free or essentially free from rickets and, second, a group of children who were definitely known from roentgenologic examinations to have had moderate or severe rickets. In addition a third group was seen, namely, those who when examined in early childhood showed evidence on clinical examination of having had rickets of moderate degree even though roentgenologic evidence was not at the time present.

Caries was more apt to occur in some of the permanent teeth of children who had had severe rickets in infancy than in those of children who had intensive antirachitic treatment. The greater number of hypoplastic defects found in the teeth of the children who had had severe rickets in infancy and the consequent increased number of areas for the mechanical lodgment of food and debris may well account for the increased incidence of caries in this group on a purely mechanical basis.

Mellanby (1930) and others concluded that hypoplastic teeth are more susceptible to caries. This opinion is not upheld by the investigations of Hess (1931) or Mackey (1931), and in the data collected by Elliot (1933) increase in the incidence of caries in hypoplastic teeth was particularly associated with hypoplastic defects in the incisor teeth.

Toverud and Toverud (1931) are of the opinion that a lack of calcium in the mother's diet is of significance in increasing the incidence of caries in the offspring. Phosphorus is thought to play the leading rôle in prevention by Lennox (1933), who based his conclusions upon the examination of the teeth and diets of thousands of African natives. It has been thought that a negative balance in these minerals is often seen in pregnant women, and that evidence of this fact was found in an increase of caries in this class. However, examinations of large numbers of pregnant women by Gerson (1921) and Ziskin (1926) indicated no increase in caries in this group.

The influence of vitamin D in the prevention of dental caries has been studied at the University of Toronto. P. G. Anderson (1934) summarizes the results of these studies as follows: The administration of vitamin D in the form of irradiated ergosterol to children living under good hygienic and dietetic conditions markedly decreased dental caries.

Diets low in vitamin C have been the object of study on the part of Howe (1933) over a period of many years. He reduced dental decay 79.21 per cent in 104 cooperative patients. He observed increases in 12.97 per cent in 28 non-cooperative patients.

An extensive study was conducted on children of the Mooseheart orphanage by Hanke (1930) and his coworkers. Their data indicate the marked reduction in the appearance of new cavities in the children who consumed large quantities of orange juice daily. The potent factor in this dietary was allegedly vitamin C.

The protective value of base forming diets against caries is strongly upheld by Jones and Pritchard (1934), Kugelmass (1934) and others. Kugelmass also emphasizes the rôle of vitamins B, C, and D.

In addition to the alleged protective factors listed above, Sprawson (1932) observed that children fed with raw milk developed teeth free from caries.

Wallace (1934) in an article on "Human Nutrition and Dental Hygiene" states, "The cause of caries is now recognized and can be defined as the undue lodgment of plaques or masses of acid-forming microorganisms together with fermentable carbohydrates when the acid formed is protected from the action of the saliva by the impermeability of the mass."

Dental caries may be arrested in diabetic or nondiabetic children by the feeding of diets low in carbohydrates according to Boyd (1933). These workers were also able to arrest caries in children with celiac disease who were fed adequate diets containing relatively large amounts of sugar.

Bunting (1935) says, "From the foregoing review, it will be seen that there are only a few definitely established facts concerning the relationship of diet to dental caries. Positive claims that are made relative thereto are largely unsustained either by the evidence submitted or by corroboration. The observations of the Michigan group that children on a known adequate high sugar diet had active caries, and that children on an inadequate low sugar diet had very little are significant, and indicate the need for further study before any definite conclusions can be drawn. Evidence submitted by this group indicates certain very important trends in the study of the problem, as follows:

"1. In a small percentage of cases, inherited tendencies or inherent characteristics may be more important factors in caries-susceptibility than any ordinary dietary consideration.

"2. In the great majority of cases, dental caries will be definitely arrested by the adoption of a simple, fairly adequate low sugar diet. The importance of the amount of sugar intake is definitely emphasized.

"3. No constant relationship could be found between the degree of activity of dental caries and the amounts of calcium, phosphorus, vitamin D or C, or acid base values in diet, or in the blood or saliva."

A coordinated report of Columbia University Dental Caries Research Group was made by Hollander in 1934. This report was based upon extensive dental research over a period of four years. The analyses of all the data lead to the conclusions: "these results obtained by our staff support the generalization that the process of dental decay is associated both with environmental factors related to food retention and Lactobacillus fermentation, and with physiological factors related to calcium phosphorus and metabolism. To date, evidence as to the mechanism whereby physiological influences operate suggests that they work through the interior of teeth rather than through saliva. The second period of our project is concerned with attempts to elucidate further the mechanism of the carious process from these several approaches."

It is quite evident from the diversity of opinion held by the group of investigators cited that more thorough study is necessary in order to determine the etiology of the lesions, called caries, seen in the teeth.

STUDIES DEALING WITH FILLINGS AS A METHOD OF CONTROL

The use of fillings has been the most common method employed by the dentist in the treatment of dental caries. In the text, *Pathology of the Hard Tissues of the Teeth,* G. V. Black says, "After decay has once begun in the dentin of a tooth, the only treatment that has thus far been found effective in preventing its progress or in curing the decay has been the complete removal of all of the carious area and the filling of the cavity with metal, or with some substance that is durable. Thus far, gold foil holds the first place as a material for filling teeth, amalgam second place, and inlays of gold and porcelain rank third."

In a report entitled "Statistical Research on Efficiency of Black's Principles in Filling Class II Cavities," Pichler (1933) states, "Records of 700 approximo-occlusal cavities (Black's Cl. II), filled, according to the teaching of G. V. Black by the present author in his private practice, with amalgam, gold foil, or gold inlays from fifteen to twenty-five years ago, were studied with reference to permanence of such filling operations, and also to determine causes and failures. In 86.7 per cent of gold-foil fillings, 84.9 per cent of cast-gold inlays, and 61.3 per cent of amalgam fillings, no recurrence of decay was found after an average of 18.5 years. This shows that gold and gold inlays were much more permanent than amalgam; also that gold inlays, even with the less exact technique of casting used in former days, are almost as good as gold-foil fillings. Recurrence of decay, when found, occurred along the buccal margin in 49.1 per cent; at the lingual, in 15.7 per cent; at the buccal and lingual, in 10.2 per cent. Recurrent decay was found more frequently in distal cavities (70.1 per cent) than in mesial (29.9 per cent). This seems to show that extension for prevention ought to have been carried out more thoroughly at the gingivo-buccal angle of the cavities."

A statistical evaluation of Hyatt's prophylactic odontotomy presented by Wisan (1933) at the conclusion of a study extending over a period of three years reveals a marked reduction in percentage of cavities occurring in the permanent molar teeth. He states, "All the permanent molars that have received prophylactic odontotomy are now in sound condition. The only perma-

nent molars that were lost in the lower grades were in the mouths of children who refused to undergo preventive treatment. The number of permanent teeth extracted was reduced markedly. It should be emphasized that the data were compiled in such a manner that they can be considered free of personal prejudice. The examination was conducted by dentists not connected with the clinic and the figures were compiled by the County School Superintendent's Office."

DISCUSSION

If we make an attempt to analyze the mass of material outlined in the foregoing paragraphs, we are forced to admit that eminent authorities after years of intensive research are not yet agreed upon the rôle played by specific bacteria in the etiology of dental caries. However, the supposition that decay is initiated by acid products of bacteria living upon the surface of the teeth is a logical deduction from the data presented. Little evidence is offered that adequately explains the mechanism that renders some people immune to this disease. It is not surprising that in an effort to answer this question, investigators have, time after time, analyzed the salivary fluids in an effort to determine its relationship to caries. The results of this tremendous volume of work are essentially negative. The great difficulties encountered in determining the quantity secreted daily, the normal constituency and the effect upon the local environment of the tooth have not been overcome.

There is one clearly demonstrable fact of practical significance that has been repeatedly stressed in the past. Carious lesions usually have their origin upon the surface of the tooth in those areas in which bacteria and debris are least disturbed by extraneous influences. Careful studies of enamel have failed to reveal definitely evidence indicating that immunity to disease is brought about by defensive mechanisms acting in this highly calcified tissue. No relationship between caries and hardness of tooth structure has been demonstrated.

The profound influence exerted upon the forming dental structures by dietary changes is illustrated in clinical and laboratory studies. As a result of research in this field, the etiology of enamel hypoplasia and mottled enamel is probably no longer an unsolved problem. There has also been a marked increase in the available knowledge relating to metabolic processes in dentin. An abundance of evidence indicates that dentin may react to injury by depositing additional inorganic salt within its matrix. It is necessary to point out, however, that careful study of the existing data indicates that dentin unlike bone does not serve as a reservoir for inorganic salts from which the body may draw in time of need. In fact, evidence has not been presented indicating that alterations of diet lead to rarefaction or resorption of formed dentin. Obvious differences between the metabolic and nutritional activity of bone and dentin exist. It is logical to assume from the data presented that the progress of caries in dentin may be internally influenced by diet.

The influence exerted upon the forming dental structures by dietary changes has led some investigators to the conclusion that these data may be applied to the problem of dental caries in toto. Careful consideration of the work that has been done on the relation of dietary changes to the incidence of caries leaves one convinced that all the causes and cures recorded cannot be right. Far too many

loopholes exist in the hypotheses that attempt to explain the part played by any or all the constituents in an adequate diet in the etiology of this disease. The mass of data concerns itself with changes occurring in dentin, whereas the lesions ordinarily have their origin on the enamel surfaces. Very little data are found on the relation of dietary changes to bacterial growth in the oral cavity. The effect of such changes on the oral environment as a whole, i.e., plaque formation, nutrient quality of food debris, salivary flow and symbiotic relation between various mouth bacteria, is not adequately known.

Many attempts to demonstrate the effect of various diets on the incidence of dental decay in laboratory animals have failed to reveal the exact mechanism by which carious lesions were brought about or prevented. It is decidedly discouraging to contemplate the variation in the incidence of dental caries in rats living on various dietary regimes. The appearance of lesions in large numbers on the teeth of animals fed adequate diets where changes have been made in the physical character of the diet or in normal masticatory stress presents a problem as profound as the one with which we are dealing in man.

The fact that caries does not have an appreciably higher incidence in hypoplastic teeth and that this incidence appears to be related primarily to the additional pitting on the tooth surfaces leads one to question seriously the effect of the lack of inorganic salts and vitamin D as etiologic agents in the production of dental decay. The high incidence of dental caries observed in children fed diets adequate in these and other respects is even more significant.

It is not my purpose to criticize unduly those investigators who have attacked the problem of dental caries, despite the fact that one cannot agree with all that is said relating to its cause and cure. I would like to take this opportunity to emphasize the tremendous value that this wealth of data contains for the research worker of the future.

The obvious inadequacy of previous methods as a means of solution to this problem is evident. Much of this inadequacy is found to exist in statistical treatment of clinical studies. The short time devoted to such studies and the far-reaching conclusions drawn from them are astounding. The evident lack of accord as to the natural history of the dental structures is a problem that must be solved before that of the etiology of dental caries may be fully understood. Certainly the mass of evidence indicates that caries is associated with acids formed by organisms living on the tooth surface. It also suggests that the existence of these organisms or the potency of their products may be altered by changing the diet of the individual.

Such a change may lead to alterations of the type of debris on the tooth surface and consequently a change in environment and nutrition of mouth organisms. This in turn may affect the incidence of dental caries. Statistical data and clinical experience reveal that metal fillings are highly efficient in controlling the disease.

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Department of Orthodontic Abstracts and Reviews

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Orthognathodontia. By Professor Edmondo Muzj. Published by the author, 1936, Via Boncompagni 10; Rome, Italy.

Orthognathodontia is an unusual book written by an unusual author. Muzj is a philosopher and one of the deepest thinkers among living orthodontists. Dissatisfied with the present diagnostic methods, he has endeavored to develop an entirely new system. In order to understand his system, it is necessary to ask why he was dissatisfied with the present methods.

DR. MUZJ.

The answer to this question has to deal with considerations of heredity and paleontology. Muzj disclaims any proof for the generally accepted theory that men are of monogenetic progeny; that the human organism has issued forth from one particular pithecoid ape whose soma changed under the influence of environment; that adaptations occurred to the new modes of life and that these adaptations were inherited by the offsprings; that under such conditions certain malocclusions could be explained as atavism, others as result of growth disharmonies between brain skull and facial bones. Therefore, the modern cephalometric diagnostic methods are faulty because they are based, directly or indirectly, upon the premises of monogenetic descent. They are specially dangerous because their anthropologic and biometric measurements lead to the artificial creation of a "norm" around which orthodontic treatment

then revolves. Muzj denies diagnostic value to measurements of points, lines, degrees, and planes. An organ as complex as the human face cannot, in its entirety, be understood by means of such measurements. This cephalometric method will therefore, despite its many and able proponents, not contribute to the advance of orthodontia. (These objections to the monogenetic descent theory are not shared by the reviewer, who considers it a well-established working theory in paleontologic, comparative anatomic and phylogenetic studies; it cannot easily be supplanted by a better one. However, Muzj is, no doubt, right in his belief that cephalographic diagnosis in orthodontia does not solve the problem in its entirety. Furthermore, what nowadays commonly is called orthodontic diagnosis is, in a strictly medical sense, not diagnosis at all but only a biologic classification of anatomic abnormalities.)

The author's own method leads in an entirely different direction and is, according to his ideas, to be considered as a system of clinical diagnosis. Its supreme motif is to examine thoroughly and to determine all symptoms before either diagnostic or therapeutic decisions are made. His method is, in distinction to the now prevailing synthetic process, an analytic one. The following fundamental principles of analysis are: (1) strict separation of morphologic examination from clinical examination; (2) separate consideration of facial deformities; (3) antithesis of the present condition (status presens) to the desired one (status futurus). Muzj uses a specially designed instrumentarium for these examinations; namely, a photographic camera which produces life size images of the head with the dentition inserted in place. In reference to this diagnostic feature, the author makes an important statement and one which gives an insight to his views. He states that more important than all measurements is the orthodontist's inborn sense of proportion ("senso di euritmia innato"). Besides his special camera, he uses a symmetroscope and an instrument to predetermine the individual norm.

By means of all etiologic factors, constitutional, morphologic, and pathologic, the author arrives at his "clinical diagnosis" which is divided into four main classes:

1. Malpositions of individual teeth.
2. Malocclusions of jaws and teeth.
3. Abnormal relations of jaws and face.
4. Facial deformities.

All these classes are further subdivided into groups and sections. It is a characteristic feature of the author's system that he is not satisfied with accurate anatomic records of the present condition, and that he does not attempt to institute treatment with an indefinite and merely visional goal in mind; but that he predetermines with mathematic accuracy the normal individual future position of the teeth, and that he then uses therapeutic measures to bring about the predetermined status.

The diagnosis in early childhood, however, is considered separately from those of children with a permanent dentition (as above described) and is based more or less on Angle's classification.

From a thorough study of the book one realizes that Muzj's system is a complete and consistent work. Whether one accepts the author's theory or not, one cannot help being impressed by his forcefulness and sincerity. The thoughts laid down in this volume deserve wider publicity and recognition. Although the present book is complete in itself, one looks forward with interest to its sequel which will deal with orthodontic treatment. Then one will be able to tell how much the author's diagnostic system accomplishes for orthodontic therapy. For, after all, treatment is the final object of all diagnosis.

Henrick Salamon, Budapest.

Federation Dentaire Internationale, Bulletin of 1937. Published by F. D. I., La Haye, 1 Scheveningsche Weg (Hollande).

The Federation Dentaire Internationale was created by the International Dental Congress in Paris in 1900 and is a permanent representation of the dental profession of the world. Its object is to form a league of national dental societies to serve as a link between the dental practitioners of all nations, and to act in matters of interest to the dental profession. It is directed by a council composed of delegates from each country. The delegates meet every year with various committees in order to deal with special matters and to prepare for the International Dental Congress. The following is a list of the Congresses held in the past:

1. 1889—Paris, President D. Gaillard
2. 1893—Chicago, President L. D. Shepard
3. 1900—Paris, President Ch. Godon
4. 1904—St. Louis, President H. J. Burkhart
5. 1909—Berlin, President Walkhoff
6. 1914—London, J. H. Mummery
7. 1926—Philadelphia, President W. H. G. Logan
8. 1931—Paris, President Geo. Villain
9. 1936—Vienna, President H. Pichler

The next Congress will be held in London during August, 1941. The officers of the Federation for the present year are: President, William H. G. Logan (Chicago); Vice Presidents, H. Euler (Breslau), W. H. Gilmour (Liverpool), A. L. J. C. van Hasselt (The Hague), H. Pichler (Vienna), M. Roy (Paris); Secretary-General, Ch. F. L. Nord (The Hague); Assistant Secretaries, A. Goia (Turin), R. Grohs (Vienna), A. Joachim (Brussels); Treasurer, A. E. Rowlett, Carisbrooke (Leicester); Honorary President, Geo. Villain (Paris); Honorary Vice-Presidents, W. Guy (Edinburgh), F. Schaeffer-Stuckert (Frankfort-on-Main). In the membership list are found representatives of the following countries: Argentine, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Cuba, Czecho-Slovakia, Denmark, Ecuador, Egypt, Finland, France, Germany, Gibraltar, Great Britain and Northern Ireland, Greece, Holland, India, Irish Free State, Italy, Japan, Jugo-Slavia, Lettland, Lithuania, Luxemburg, Malta, Monte Carlo, Netherlands Indies, New Zealand,

Nicaragua, Norway, Palestine, Peru, Poland, Portugal, South Africa, Spain, Sweden, Switzerland, Syria, Turkey, United States, Uruguay. Thirty-six national associations adhere to the F. D. I., the United States being represented by the American Dental Association.

The Transactions of the Vienna Congress include a number of annual reports, the most interesting one being submitted by Dr. A. Joachim on "Events of Special Professional Interest in Various Countries." It contains a concise review of the main events which have taken place in the professional life of various countries, thereby illustrating the spirit which animates the profession from the standpoint of scientific progress as well as from the social point of view. The report is compiled from answers to questionnaires which were received from more than twenty countries, and it covers in a most instructive manner such problems as: preliminary, graduate, and postgraduate instruction; requirements for degrees; regulations for dental practice set up by the governments; the principal publications during the report period; meetings of the national and local societies.

Some countries, like Belgium, for instance, have passed legislation to prohibit the practice of dentistry by physicians without a special dental license. On the other hand, other countries are endeavoring to give their dentists a broader medical background. Poland is reorganizing professional instruction by shortening the course of general medical study to two and one-half years for those candidates who wish to specialize. After that the students have to take a course in their special subject which lasts from two to five years. One of the special subjects is dentistry. (The reviewer considers this method the ideal solution of the problem of dental education.) In Czecho-Slovakia, as in Austria, the dental student must first complete the regular course in medicine and then take a special course of two years' duration. Similar legislation is under consideration in Italy and in France; in the latter country the practice of dentistry by foreigners has also been made an object of new government regulation. In Germany, all scientific dental societies were, by government orders, merged into one large organization. Great Britain has increased the full time professorships in Dental Surgery from 8 to 10, by the addition of a professorship at the Universities of Birmingham and Newcastle. This was made possible through grants from the Dental Board of the United Kingdom, whose income is derived from the licensing fees of dentists. In New Zealand, the dental course lasts four and one-half years and confers the title of B.D.S. The title of D.D.S. can only be obtained five years after graduation, by submitting a thesis and passing special examinations. In Switzerland, the dental course has been extended to four and one-half years in order to include thorough medical training. In several countries, the dental technicians are permitted to perform a more or less limited number of dental services, but the dental societies are using their influence to curb this practice.

In order to improve dental hygiene in the colonies, Belgium has ordered that a certificate of dental health must be furnished by families before their departure for the Kongo. During 1935, 220,000 Czecho-Slovakian children received dental care at their schools. Finland has the largest number of

women dentists, namely, 69.4 per cent in 1935, while at present only 6 men are among the 25 candidates admitted. The Association of Finnish dentists has fixed minimum fees below which dentists are prohibited to work in private practice, but dental clinics will take care of the poor. In Poland, women dentists outnumber men by four to one.

The International Miller Prize was awarded to Dr. Maurice Roy (Paris), for his contribution to the study of alveolar pyorrhea; to Dr. Bernhard Gottlieb (Vienna), in recognition of his scientific research work; and to Dr. Anton Cieszynski (Lwow), for his accomplishments in radiology, anesthetics, surgery and gnathostatics.

The following resolution was adopted unanimously: "In view of the importance of public health, it is essential—if necessary after a certain transition period—that in the future only those should be allowed to practice who have taken an approved course of instruction, which is given under university control and which must contain an adequate basis of medical knowledge."

The bulletin is printed in three sections, in English, French and German, and contains a number of blanks for applications for membership.

Egon Neustadt.

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General Anesthesia

Endotracheal Anesthesia in Surgery of the Head and Neck. Ralph Hargrave, Anesthesia & Analgesia **16**: 181, 1937.

Endotracheal anesthesia protects the tracheobronchial tree from contamination during surgical operations on the mouth and nose. Correct technique of intubation (introduction of catheter or tube) is of great importance. The indirect and the direct methods are described. The writers uses cyclopropane with carbon dioxid absorption technique in all anesthesias in the Toronto Western Hospital.

In surgery inside the mouth he passes the endotracheal tube by direct vision through the mouth and allows it to come out one corner of the mouth, transferring the tube over to the side which is not being operated upon. The pharynx is closed around the tube with a moist pack.

Precautions are necessary, especially when the surgeon uses an electric cautery or coagulator. The anesthetist must immediately wash out all the cyclopropane and replace it with a mixture of nitrous oxide and oxygen because of the inflammability of cyclopropane. Also the patient should not be allowed to leave the operating room until all reflexes have returned.

General Anesthesia in Dental Surgery, New Anesthetic Agents. L. F. Anderson, Dental Digest **43**: 281, 1937.

This article deals with the newer anesthetics and their use, and is written by an expert anesthetist. He prefers cyclopropane as it has advantages possessed by no other anesthetic now in use, being nearly ideal in most cases when used with carbon dioxid absorption technique.

The advantages of this technique are as follows: Respiration is quieter and shallower; perspiration is greatly lessened; body heat is retained; dangers of lung complications are lessened; circulatory disturbances and shock are infrequent; explosions are virtually impossible from static electricity owing to the increased humidity in the closed system of the anesthesia machine, although open flames, smoking or the use of high frequency equipment and electric cauteries must not be used near the anesthesia apparatus.

Advantages of cyclopropane: Induction is not accompanied by a feeling of suffocation and a falling sensation as with nitrous oxide and oxygen. The odor is not disagreeable. There is no oxygen want (85 per cent oxygen is used). Only enough cyclopropane is given to produce anesthesia, allowing for

a greater amount of safety and elimination of dangers caused by anoxemia. The lethal dose is at least twice the anesthetic dose, and when lethal doses are given the respiratory depression is predominant.

Disadvantages of cyclopropane: It is a potent agent and should be used only by qualified anesthetists. Some surgeons believe that there is more bleeding when this agent is used. It is costlier than other anesthetics.

Eunarcon for Short Anesthesia in the Office (Eunarcon das Kurznarkotikum für die Sprechstunde). L. Lindenstein, Zentralbl. f. Chir. **62**: 1402, 1935.

Eunarcon is the sodium salt of isopropyl-C-bromallyl-N-methyl-malonylureids, furnished in 5 and 10 c.c. ampules, in 10 per cent solution. It should be injected intravenously, 1 c.c. per minute. Morphia should not be given as premedication as it may cause damage to the respiratory center. Before 3 c.c. are injected, the patient begins to go to sleep quietly without going through an exciting stage. With 5 c.c., short and simple office operations may be successfully performed. For longer hospital operations 8 to 10 c.c. are injected. The dosage depends on the age and weight of the patient, and should be gauged by watching such symptoms as the cornea reflex, the dilation of the pupils, and the breathing. The writer recommends that the same amount needed to produce sleep should be injected additionally. With 5 c.c. injected, sleep will last five to twenty minutes and will allow the incision of an abscess, the excision of small tumors, the extraction of teeth, the reduction of a fracture, etc. The eunarcon is said to produce no nausea and vomiting, and patients may be dismissed one-half hour after awaking.

Basal Anesthesia With Evipal Soluble Administered Rectally. Philip J. McNellis, Anesthesia & Analgesia **16**: 193, 1937.

In 1820 patients ranging from the ages of eight to eighty-two, evipal soluble has been used without fatalities or complications. The use was restricted to minor surgery of short duration. The last six months clinical investigations were carried on with evipal soluble administered rectally as a basal anesthetic for major operations. The method outlined by Gwathemy was used, administering 0.02 gram per pound of body weight in a 10 per cent solution of distilled water. Greater dilution was found to cause more rapid absorption and sleep, and earlier awakening. In poor anesthetic risks the dosage should be decreased from 10 to 20 per cent. It is supplemented with inhalation anesthesia.

Its use has the following advantages: It eliminates the dread of going to the operating room; there is no change in respiration, pulse rate, or blood pressure; by-effects such as restlessness, nausea, and headache are decreased since the amount of supplemental anesthesia is greatly reduced.

Evipannatrium in Local Anesthesia (Evipannatrium in der Localanästhesie). Georg Lotheissen, Zentralbl. f. Chir. **62**: 569, 1935.

The writer points out that in more extensive operations under local anesthesia it is important to consider the psychic influences on the patient. He recommends the administration of 0.01 to 0.02 morphia three-quarters of an hour

before operation, and 10 c.c. of a 10 per cent evipan-sodium solution by intramuscular injection one-quarter of an hour before operation. Even the most nervous and agitated patient will submit by this method to operations under local anesthesia.

The Newer Methods of Anesthesia and Their Uses in Dentistry (Die neuen Narkoseverfahren und ihre Verwendbarkeit in der Zahnheilkunde). Emil Haubenreiser, Deutsch. Zahnärztl. Wchnschr. **38**: 102, 1935.

After discussing various types of anesthesia the writer gives the important advice not to use evipan sodium as a complete anesthetic in ambulatory cases or in office practice as it produces prolonged sleep.

The Importance of Dilaudid in Evipananesthesia (Die Wichtigkeit von Dilaudid bei Evipannarkosen). W. Weigel, Zentralbl. f. Chir. **62**: 1273, 1935.

The writer recommends premedication with 0.002 dilaudid one-half to three-quarters of an hour before evipan anesthesia. For children, only one-quarter to one-half the amount. He claims that such medication will keep the patient absolutely quiet, and will double or triple the effect of the anesthesia, prolonging its duration.

The Development of Anesthesia Procedures and the Use of Medicaments to Cause Awakening (Entwicklung der Betäubungs verfahren und Gebrauch von Weckmitteln). C. M. Behrend, Med. Welt. **9**: 747, 1935.

The use of coramin and cardiazol is recommended to shorten sleep after operations with rectal or intravenous anesthesia. In case of conditions endangering the patient's life 9 to 10 c.c. may be given intravenously.

Editorials

Presentation of the Albert H. Ketcham Award at the Thirty-Fifth Annual Meeting of the American Society of Orthodontists, Chicago, 1937

Dr. Albert Henry Ketcham
1870-1935

EVER since Dr. Ketcham's death there has been a growing feeling among his host of friends, and especially in the minds of his close coworkers, that a permanent memorial should be established. This has now culminated in accomplishment, and the type of memorial established is particularly fitting, for chief among Dr. Ketcham's wonderful attributes was his desire to assist the young men of his profession. It was a similar urge that activated him to spend the tremendous amount of energy necessary in the formation of the American Board of Orthodontia.

In a brief résumé it may be said that Dr. Ketcham's life is another example of a great man who rose to the heights of his calling through his own efforts. Born on a Vermont farm in 1870, he inherited from his ancestors many of the strong characteristics of the early New England pioneers. In the environment of the home of his grandfather, a physician, as a small child Albert played about the table where the pills prescribed to the patients were rolled. Thus from early childhood his desire and ambition to be a professional man were formed and stimulated.

He chopped wood to help earn his way through the Vermont Academy at Saxtons River. When still in his teens he associated himself with his uncle, his mother's brother, Dr. W. H. Wright, a dentist of Brandon, Vt. An amusing incident occurred during his association with his uncle. Dr. Wright was a tall, dignified man who habitually wore a high silk hat. It was his custom when he entered the office in the morning to place the plug hat over a peg in the corner of his laboratory. Albert had been working hard on a bow and arrow, and looking about the office for a suitable target, spied the round top of the hat and let fly, planting the arrow exactly in the center of the doctor's high silk hat. Dr. Ketcham's love of the hunt was beginning to express itself.

After a year in Dr. Wright's office, he entered the Boston Dental College, from which he received the degree of D.D.S. in 1892. Following his graduation he was given a position of clinical instructor in operative dentistry in the college, which with his private practice occupied him until the fall of 1895 when he developed pulmonary tuberculosis. He first went to Saranac Lake, but not improving as he thought he should, moved to Colorado and in the "chase for the cure" arrived eventually at Meeker, Colorado. When he had regained his strength, he could not resist the temptation to practice dentistry and soon rigged

up a dental chair, using a stockman's saddle as the seat, and with but few instruments and meager equipment he administered to the dental needs of the cowboys and others in the vicinity. At this time he also did considerable big game hunting in the White River country, a hunter's paradise, later made famous by Theodore Roosevelt. A most interesting article was written by Dr. Ketcham on the subject of Bear Hunting, and published in *Outdoor Life* about 1896. The article was characteristic, particularly in the minute detail given to the description of the country.

Dr. Ketcham was a lover of nature and a keen observer of all of her phases and changes. Being interested in photography he became expert in all branches of that art. The illustrations of most of his articles, both professional and avocational, were made with his own camera. His knowledge of lenses and dark room procedure was the best obtainable.

He moved to Denver in 1897 and became instructor in the University of Denver, Dental College, entering general practice the next year in addition to carrying on his work as instructor in crown and bridge, and orthodontia.

Dr. Edward H. Angle was a guest of the Colorado State Dental Association about this time, and from him Dr. Ketcham received the inspiration to specialize in orthodontia, attending the Angle School of Orthodontia in 1902. He returned to Denver and was among the first to limit himself to the exclusive practice of orthodontia. A letter from Dr. Angle, dated January 16, 1913, written to Dr. Kirk, Philadelphia, contains the following: "Dr. Ketcham is doing the best work that is being done in Orthodontia in America today. His illustrations are always beautiful and truthful. . . ."

Dr. Ketcham was one of the pioneers in x-ray work, and designed and constructed many pieces of apparatus for dental x-ray practice, receiving a patent on a dental film holder.

He was the type of man who was happiest when working; was a tireless worker, and few realize the many hours he spent outside his office in the interest of orthodontia. Most of his evenings were spent at home writing or studying. And it must be remembered that all his accomplishments were under the handicap of poor health. Chief among his drawbacks was extremely bad eyesight. This defective vision was a great cross, but he bore it bravely, as he did the loss of his right hand thumb.

He worked just as strenuously at his leisure time occupations, which were mostly camping, hunting and fishing, as he did in his professional activities. He was an expert shot, with both rifle and shotgun. One of the outstanding events of the year was his annual trip to the Bear River Duck Club in Utah, where it was his custom to bag the limit each day to send to his friends the country over. He was also an expert fly fisherman and, although he had fished the streams of Colorado for some thirty years, it was typical of the man to enroll in a casting club for instruction when a professional instructor came to town a year or so before his death.

Dr. Ketcham had an open mind and was continually seeking the latest and best in all he did. He was a charming host and, together with Mrs. Ketcham, derived great pleasure in entertaining his many orthodontist friends from the east and south at his summer home, Lake Edith. Also, many red letter days

were spent in fishing trips to the North Park country in the company of his orthodontist friends. Practically all his leisure time was spent in active recreation; likewise in his office there was never an idle moment for either him or his associates. The accurate records of every case treated by him from 1902 until the date of his death are an inspiration to all who see them. Most of his earlier x-ray pictures were made with photographer's film which he carefully prepared in his own dark room by cutting to size and wrapping in black paper.

It was his custom to check all the cases frequently during active treatment and for years afterward, and such study led to his papers on the subject of root resorption. He was also tremendously interested in all other research and while he always considered himself only a practitioner, he was constantly stimulating others to engage in orthodontic research. He was honored by membership, or honorary membership, in most of the organized dental and orthodontic societies. He was quick to accept and eager to work on all committee appointments assigned to him. This is attested by his tremendous amount of work, above referred to, in the formation of the American Board of Orthodontia. He served as President of the American Society of Orthodontists, and was the first President of the American Board of Orthodontia.

While Dr. Ketcham was truly a student, an author, an inventor, a teacher, he was most of all—a friend.

Dr. Frederic T. Murlless, Jr.

President Albert W. Crosby's Remarks in Presenting the Albert H. Ketcham Memorial Award to Dr. John Valentine Mershon

Many of us recall the memorable address given by Albert H. Ketcham, our then retiring president, at Estes Park in the summer of 1929. After relating things accomplished, he made some suggestions which he thought would promote a higher professional standing in this first specialty of dentistry and one well suited to the ideals of so worthy a society as this of ours.

The suggestion that a Board be established which would have for its aims a greater proficiency in its members by encouraging its men to keep better informed on the literature pertaining to our specialty, to keep better and more complete records of their cases and to be able to put this knowledge into essay form.

The condition in all specialties of medicine as well as dentistry is now such that any graduate in either profession can announce that he specializes in a named branch of a healing art however meager his preparation may be.

Much thought has been given in both professions as to how to improve the educational standing among its members, and a step forward was made when such boards were established as the formation of the American Board of Otolaryngology, to mention but one. We cite this board because it is the one upon which the American Board of Orthodontia is modeled. Sincere acknowledgment is made for its great help given Dr. Ketcham in developing the plan on which our board now functions.

The recognition of the desirability of such a step was so well received that a board was formed and began to operate the following year. More than one-third of our members have already qualified and have been certified by the Board. The outlook promises that most of our new members will qualify after they have been in exclusive practice the necessary five or more years.

This brief epitome shows why, in particular, the American Board of Orthodontia and Dr. Ketcham's many friends thought that the bestowal of an award each year on one who has made some notable contribution to orthodontia, science, or literature, of interest to our specialty, would be a suitable memorial to one who was so interested and absorbed in the advancement of this art and science. If this were Dr. Ketcham's only contribution, his name would be perpetuated but he was one of the pioneers in orthodontic education, did especially fine research work in roentgenology and was associated with every forward movement.

It is particularly appropriate that the first award of this parchment should go to one who exemplifies so many of the qualities of Dr. Ketcham.

Let us look for a moment to Dr. Mershon's history, to sum up the transcendant qualities we so much admire: He is a great teacher and leader, a pioneer in our specialty and, above all, has a great capacity for making and holding friends.

To quote from "The Rotary Felloe"

FRIENDS

The happiest business in the world
  Is that of making friends
And no investment on the street
  Pays larger dividends.

For life is more than stocks and bonds
  And love than rate per cent
And he who gives in friendship's name
  Shall reap as he has spent.

Life is the Great Investment
  And no man lives in vain
Who guards a hundred friendships
  As a miser guards his gain.

Then give the world a welcome
  Each day, whate'er it sends,
And may no mortgage e'er foreclose
  The partnership of friends.

And to you, John, Uncle John, as you are affectionately known to so many of us, to you who possess the ideals and qualities which he admired and exemplified, we present this, the first award of the Ketcham Memorial Parchment, in memory of our beloved past president and organizer of the American Board of Orthodontia.

Biographical Survey of John Valentine Mershon

Born on farm at Penn's Manor, Pennsylvania, which was the summer home of William Penn.

His education began in the little red brick schoolhouse at Penn's Manor. Doctor Mershon later attended the Model School at Trenton, New Jersey; in

1889 he was graduated from the Pennsylvania Dental College. He served as instructor at that institution for a number of years.

He practiced general dentistry for nineteen years. He has practiced orthodontia since 1908, the year in which he was graduated from the Angle School.

Doctor Mershon headed the orthodontic department of the University of Pennsylvania from 1916 to 1924, inclusive.

He has done a great deal of postgraduate orthodontic teaching in various parts of the country, always without accepting any remuneration. The students in these courses came from all parts of the world. Requests for advice and help reach Doctor Mershon constantly from these men and from many others, and it is always freely given.

Doctor Mershon has contributed numerous articles to orthodontic literature. He was one of the first to approach the subject of orthodontia from the biologic viewpoint, and most of his writings develop the biologic and philosophic concept of orthodontia.

Doctor Mershon evolved the lingual arch for his own use. He gave it to the profession free (he has never had anything patented) when the need for it became known.

He formed the first study club in the United States for practicing dentists in conjunction with their dental society activities.

In May, 1930, he received the William Jarvie Fellowship Medal from the Dental Society of the State of New York, for outstanding contributions to dentistry.

On May 18, 1933, he received the Doctor of Science degree from the University of Pennsylvania for exceptional services to dentistry.

He served as president of the American Society of Orthodontists, the Academy of Stomatology (Philadelphia), and the New York Society of Orthodontists.

He is a member of: The American Society of Orthodontists, the New York Society of Orthodontists, Southern Society of Orthodontists (Honorary), Southwestern Society of Orthodontists (Honorary), Pacific Coast Society of Orthodontists (Honorary), European Orthodontological Society (Honorary), the American Dental Association, the Pennsylvania State Dental Society, the First District Dental Society, the Academy of Stomatology.

Dr. Mershon's Remarks in Accepting the Award

Dr. Ketcham, you have passed to the Great Beyond but you still live!

Words are used to express ideas but on this occasion they cannot convey one's feelings.

If I have done anything or given anything for the children of the world which would entitle me to this honor, I can only say that it was a gift of God which I was permitted to administer.

Dr. William J. Brady
1862—1937

AN ERA is closing, in which both personable and individualistic men who led the vanguard of a new art and science, *orthodontia*, are rapidly passing—an era in which men are known for the things they have created, for the ideas they have sponsored and particularly are they identified by the orthodontists who have come under their tutelage and influence. The careers of these men are of great interest to the present generation of practicing orthodontists. One of the able and certainly one of the best loved of these teachers was the late William J. Brady of Kansas City, Missouri. Dr. Brady died August 17.

The Civil War was just getting under way when he was born; there was pandemonium, a display of patriotism, and calls for troops. His father, John Brady, enlisted in the 83rd Illinois Volunteers and left for the front, while infant Brady, with his mother, went to Little York, Illinois, to reside with her father. At seventeen, William J. started to high school at Millersburg; also he learned to "play the fiddle." The next year he entered Aledo and, while teaching a country school at Pomeroy, Illinois, he met Dr. T. G. Vernon, who inspired him to study dentistry and make it his life's work.

At the age of twenty-two, Brady entered the dental department of the University of Iowa, and was graduated in March, 1886, valedictorian of his class. With Dr. Vernon, he opened an office in Marengo, Iowa. In 1888 he attended the Iowa state meeting, where he first met Doctors Angle and Weeks, who at that time were located in Minneapolis. In July of that year he became teacher in the dental department of the University of Minnesota, where he went immediately to make charts for Angle and Weeks, and while teaching there he maintained an office at Excelsior, to which he made trips Saturdays and during summer vacation. From Minnesota, he went to teach in the Chicago College of Dental Surgery; and while in Chicago he became acquainted with Miss Augusta Hockert, "quit dental college work for good" and left for Minneapolis, and on July 1, 1888, the Brady-Hockert wedding took place.

Dr. Brady then practiced in Minnesota, thirty or forty miles from any other dentist. He received a flattering offer to teach in the Missouri Dental College at St. Louis; where he taught for one term and again "quit for good"; then he went to Louisiana, Missouri, to become associated with Dr. Burkhead. He next served on the faculty of the Western Dental College for six years; then returned to the State University of Iowa, and started an orthodontic practice at Cedar Rapids, Saturdays only. In 1906, he returned to Kansas City and opened an office for orthodontic practice exclusively and resumed lecturing at the Western Dental College. In 1915, Dr. Brady reorganized the International School of Orthodontia, a private school which had previously been started by a St. Louis group. He incorporated the school and taught the first class of ten dentists who came from eight states. Since 1915 he had been acting as dean of that school in Kansas City, Missouri.

Dr. Brady invented many dental devices and used motion pictures in his classes as early as 1915. His lectures were illustrated with crayons and charts of his own making, and in these lectures he gave practical demonstrations of

the special instruments he had invented. In 1917 he was an authorized examiner for dental applicants for service in the World War. He was a past president and a life member of the Kansas City Dental Society, a member of the Missouri State Dental Association, a charter member of the American Society of Orthodontists, a life member of the Psi Omega Dental Fraternity, honorary member of the Omicron Kappa Upsilon Fraternity and belonged to the Masonic Order.

This year defective eye-sight and poor health overtook Dr. Brady. His death marks the close of another important and influential orthodontic career.

When the final history is written of the meteoric rise of orthodontia during the early years of the Twentieth Century, the name of Dr. William J. Brady will appear as one of its fine teachers. Who can appraise the quality of a man better than his students? With one voice they mourn the loss of a great teacher and a lovable man, sincere in his attachment to the vocation in which he chose to spend his life.

Dr. William J. Brady, at the age of seventy-five years, closes the chapter of an interesting and constructive orthodontic career, but leaves to posterity a host of friends and many enthusiastic protégés to carry on in his footsteps.

We are indebted to Dr. Hugh Tanzey of Kansas City, Missouri, one of Dr. Brady's close friends, for many of the notes pertaining to Dr. Brady's life.

H. C. P.

News and Notes

Great Lakes Association of Orthodontists

The meeting of the Great Lakes Association will be held in Cleveland, November 1 and 2.

Southern Society of Orthodontists

The sixteenth annual meeting of the Southern Society of Orthodontists will be held at the Hotel Cleveland, Spartanburg, South Carolina, on February 7 and 8, 1938. All ethical members of the dental and medical professions are cordially invited.

CLYDE O. WELLS, President,
828 Montgomery Building,
Spartanburg, S. C.

WILLIAM P. WOOD, JR., Secretary,
442 W. Lafayette Street,
Tampa, Florida.

North Carolina Dental Society

The sixty-fourth annual meeting of the North Carolina Dental Society will be held at the Robert E. Lee Hotel in Winston-Salem, N. C., May 2-4, 1938. All members of the American Dental Association are cordially invited to attend.

FRANK O. ALFORD, Sec.-Treas.,
1109 First National Bank Bldg.,
Charlotte, N. C.

Orthodontic Directory of the World

The 1938 edition of the Orthodontic Directory of the World is now in the process of compilation. Those eligible for listing may communicate with the editor concerning same.

CLAUDE R. WOOD, Editor
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Knoxville, Tenn.